

HOW MUCH OIL IS LEFT?

* POPULAR MECHANICS

MAGAZINE

MAY
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PRINTED IN U.S.A. FOR THE U.S. WAR BONDS AND STAMPS CAMPAIGN

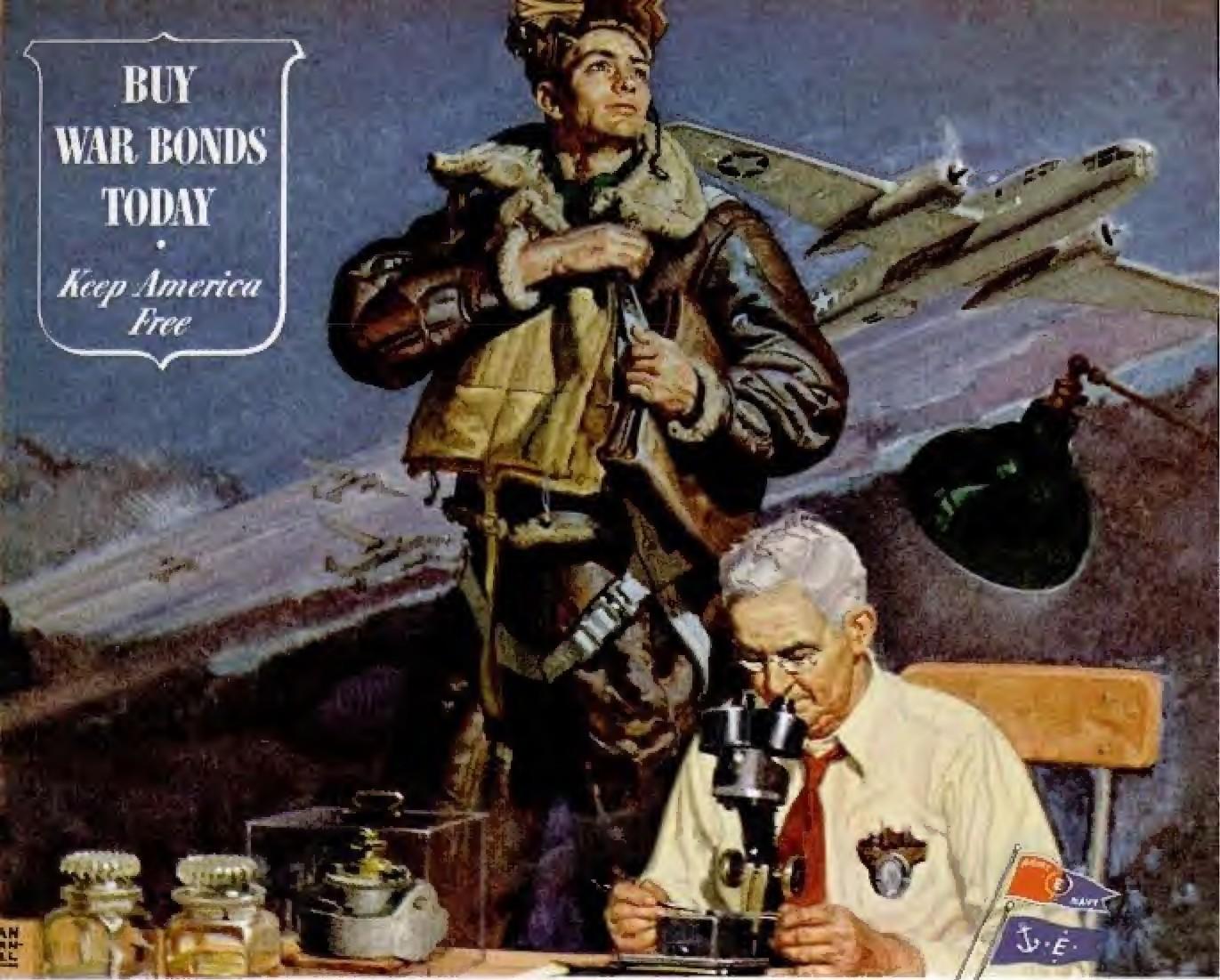
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BUY UNITED STATES
WAR SAVINGS
BONDS AND STAMPS

SEE PAGE 27

**BUY
WAR BONDS
TODAY**

*Keep America
Free*



Hands across the sky

FROM the skillful hands of our craftsmen to the welcoming hands of airplane pilots, three amazing instruments are now flowing steadily and in volume.

These are the gyro-horizon, the directional gyro, and the remote indicating compass. The first two were designed by Sperry, and are built by Sperry and Fisher Body. The latter was designed by Bendix, and is built by Bendix and Fisher Body.

To meet their specifications, in the volume required, was a challenge to Fisher technicians.

But true craftsmanship knows no limits. And the extreme precision demanded in the manufacture of these instruments was but

The Army-Navy "E" flies above four Fisher Body plants for excellence in aircraft production and from two others for tank production, while the Navy "E," with four stars, is flown by still another Fisher Body plant for its naval ordnance work.

an extension of notably accurate work done on bombers, gun-breech housings, tanks, anti-aircraft guns, and other armament.

We have learned to bank on craftsmanship — to depend on it. And any time our fighting men need a technical plus to put them in the clear, we'll burn the lights every night till they get it.

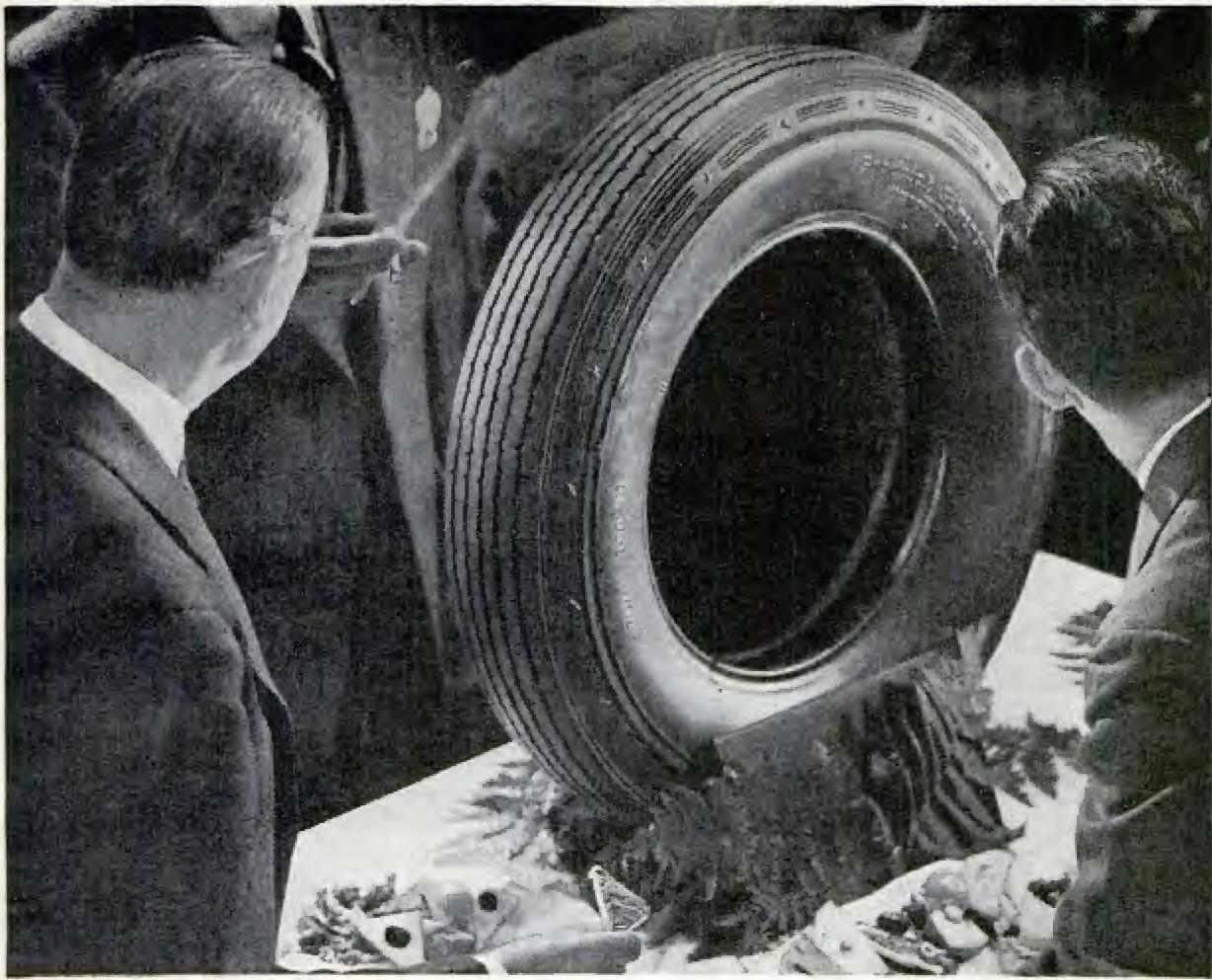
Every Sunday Afternoon
GENERAL MOTORS SYMPHONY OF THE AIR
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armament
BODY BY

Fisher

DIVISION OF GENERAL MOTORS



Reception for an automobile tire

**The guests asked a question that
was answered 80 million miles later**

THEY WATCHED intently that June afternoon in 1940, eighteen months before Pearl Harbor. A tiny cardboard ship moved across a map of the Atlantic Ocean. The president of B. F. Goodrich described the little ship's voyage—bringing rubber from Malaya through the Suez to New York.

Suddenly the ship exploded, disappeared. The business men, editors and reporters in the Empire Room of New York's Waldorf-Astoria got the point even though many still said it was "a very remote possibility."

Turning, they saw a tire unveiled. It looked like any other tire . . . but more than half its natural rubber had been replaced

by the new B. F. Goodrich synthetic. It was the first tire containing synthetic rubber ever offered for sale to American car owners.

The price had to be one-third higher than current tire prices. But that didn't stop people from buying. Even owners of large fleets bought. These new tires traveled in every state, in all kinds of weather, on all types of roads.

Today they have totaled more than 80,000,000 miles. And the question everyone had asked—"How good is synthetic rubber, anyway?"—is answered by actual reports from car owners. Mileages in excess of 30,000 miles were reported. Some reported as much as 50,000 miles!

The tires that B. F. Goodrich makes for passenger cars today are all-synthetic (98%) and are almost as good as the tires that were made before the war. Truck tires aren't yet as good, especially in intercity service with overloads, but are being improved day by day. But the important thing is those extra years of experience . . . they are the reason so many motorists who qualify get their tires from B. F. Goodrich Silvertown Stores and dealers. *The B. F. Goodrich Company, Akron, Ohio.*



In war or peace
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This One



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Popular Mechanics Magazine

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H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

May, 1944

Vol. 81, No. 5

Next Month

TWO Seabees on liberty went souvenir hunting on a Pacific isle. They wanted a Jap flag or tea set for the girls back home. They met, instead, two Japs carrying rifles. They were unarmed, but by proper use of their fists the Seabees obtained their souvenirs: two Jap rifles. These fighting engineers of the Navy are tough and proud of it. Five of them crawled into a burning boxcar loaded with ammunition and put out the fire. A Seabee patrol scouted a Jap-held island, then greeted amazed Marine Raiders when they landed. For a look at these "Horny-Handed Heroes," see the June issue.

Aviation Grows Up

IN weather that had grounded all other craft, a helicopter landed the other day on the toe of Manhattan, picked up two cases of blood plasma and flew to the aid of survivors of a sunken destroyer. The helicopter had grown up and gone to work. But is it ready for your backyard hangar? There are a lot of glib predictions. "Aviation in Long Pants," a June feature, scans the sky for postwar probabilities, tells of our air lines' plans for 350,000 miles of routes girdling the globe.

Miracle Crops

NECESSITY is the mother of chemurgy. When the Japs grabbed everything from Paramushiro to New Guinea they deprived us of rope from abaca fiber, starch from cassava, rubber and palm oil and shellac. The substitutes we have grown may be the basis of postwar prosperity. Read "Growing a New World" in June.

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Lifeline of the Fleet

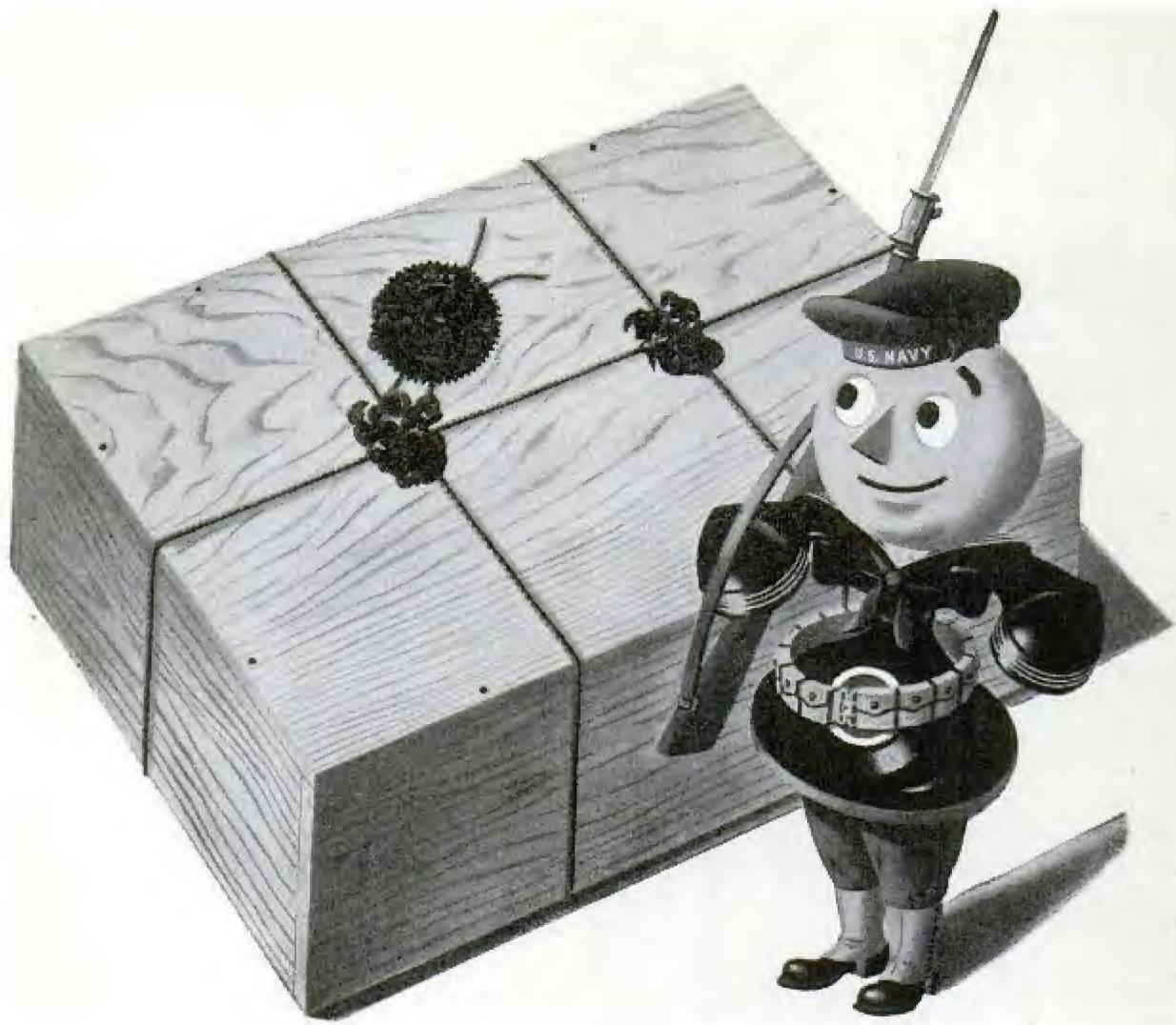
WHEN a Navy patrol bomber was marooned for 15 days in an Alaskan blizzard with the wind blowing at 130 knots, the crew survived without even a frostbitten toe. The Navy Bureau of Supplies had thought of everything, down to the woolen socks. Its task in provisioning the world's greatest Navy is gargantuan. To send a cruiser to sea for a month it must supply 15,000 barrels of oil, 9,900 pairs of socks, 40,000 pounds of meat, 11,000 pounds of butter, eggs and cheese, 50 tons of fruit and vegetables, tons of munitions and stores. Next month the Bureau's Chief, Admiral Young, tells how the job is done.

Magnesium, the Lightweight Giant

YOU never heard of Nevada's third largest city. The citizens of Henderson, Nev., just got around to naming it a few months ago. Two years ago it wasn't there; today it is a modern community of 10,000, site of the world's largest magnesium producing plant. That plant uses one-third of the generating capacity of Boulder Dam in turning out the light metal for our warplanes and incendiary bombs, the light metal of your postwar pots and pans. Read about this modern miracle in June.

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IT HELPED WIN A GREAT BATTLE

Sealed in this box and deposited in the vaults of the Bell Telephone Laboratories is a special device that helped win a great battle. It is being preserved for its historical significance.

SUCH things do not just happen. New instruments of war may appear suddenly on the battle-fronts. But behind them are long years of patient preparation.

Our scientists were organized to have this device ready for battle—just as our fighting forces were organized to be ready for that battle.

Developing secret military devices is a big job but big forces are busy on it, day and night.

Concentrating on this job are more than 7000 people in the Bell Telephone Laboratories. Its scientists and engineers and their skilled associates form a highly organized team, experienced in working things out.

Today's work for war had its beginning many years ago when these laboratories were founded as part of the Bell System's service to the public.



BELL TELEPHONE SYSTEM



MEET YOUR NEW NEIGHBOR

Everyone knows that the world is growing smaller through the development of Science and Industry—the War is a grim reminder of this fact... but when the job of war is done and the Peace is won the world will become a Neighborhood of Nations—working and living together for their mutual betterment.

Radio will serve the world in a measure far greater than ever before—for pleasure, education, safety and convenience of all mankind!

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BONDS

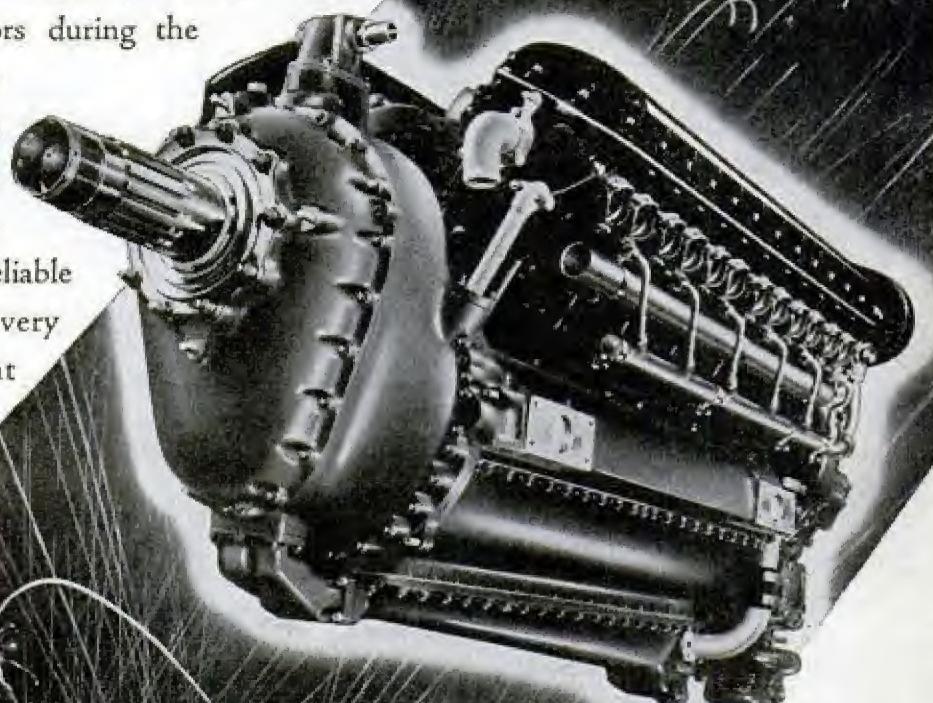


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Business Demands Accountants



... because Accountants Command Business

Accountants are usually in demand—at better than average earnings.

But today—more than ever before—the competent accountant finds his services at a premium.

Business in war has tightened up the reins and is watching costs—prices—every move—striving to operate on that basis of close control so essential to service and profits.

Then, too, business is working under tighter government regulations, with many more records and reports—war production, priorities, more and larger taxes, wage and hour laws, payroll deductions for Defense Bonds, etc., etc.

The Home Study Way to Accountancy Success

Thousands upon thousands of men have trained for Accountancy with LaSalle—at night—at home.

Their success—their progress—is a matter of record.

Whether their goal was a C. P. A. certificate or advancement in business, our files are full of letters reporting income increases far out of line with the time and cost investment.

Note for instance, these six cases out of many we might cite. (Names on request.)

A cost clerk, J. S. H. became, after completing 30 training assignments, cost accountant. Within nine months, only half through the course, he became chief cost accountant with a salary nearly four times what it was when he enrolled. C. K. was an immigrant day laborer. Within a few months he secured a bookkeeping job. Within a year, he secured three raises. In two years, he was in charge of his company's accounting department, although not yet through the training. W. J. F. moved up from store clerk to assistant bookkeeper after the first ten lessons. Now he is office manager.

S. W. N. knew nothing about bookkeeping. With 19 months of training he passed the C. P. A. examination on first attempt and opened his own public accounting office. Although a university graduate, P. M. was a grocery clerk at small wages. Today he is Secretary and Credit Manager with an income 300 per cent higher. Already in cost work, G. N. P. within nine months was earning 40% more; within two years, 100% more. The third year his income went up still more. Now he is manager.

These Men Won Success in Ordinary Times —You Have War Opportunities

Remarkable as is the success of these men—you will have an advantage over them—you will be entering accountancy when unusual national conditions work with you for success.

Conditions not only call for more accountants—but offer unusual opportunities for both quick and permanent success. The need for accountants will increase during war and will continue for years afterwards during the difficult post-war adjustment period.

—If You Can Qualify

Ask yourself three questions:

1. Are you ambitious?
2. Have you determination?
3. Can you see and grasp an opportunity?

If you have determination; if you are ambitious; if you can take advantage of circumstances—prove it by investigating. A three-cent stamp, sixty seconds time, and the coupon below will bring you full information regarding Accountancy training and the opportunities to which such training leads. Then you can judge intelligently.

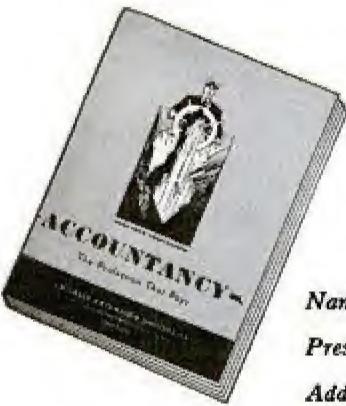
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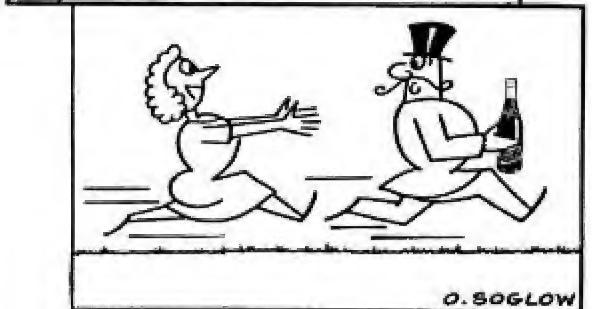
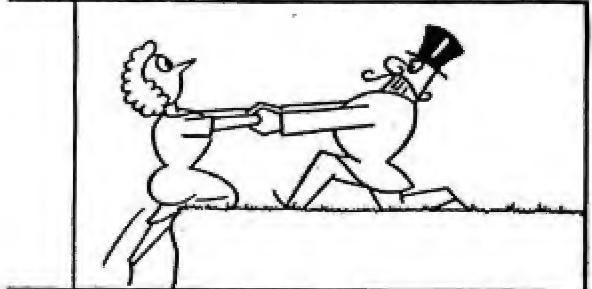
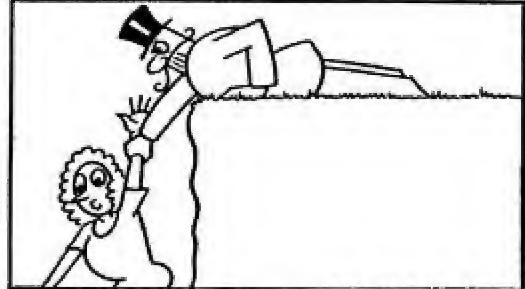
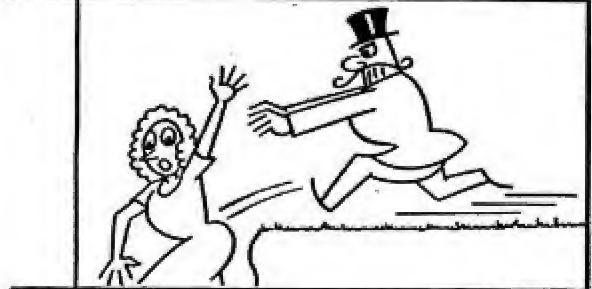
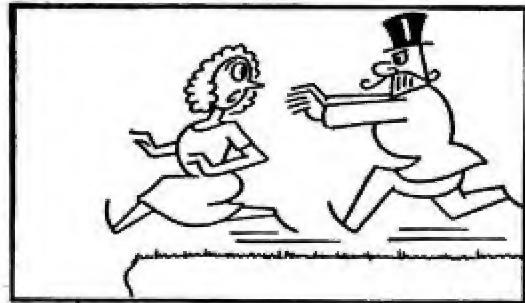
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O. SOGLOW

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IMPORTANT NOTICE

It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described in order to avoid possible liability for patent infringement.

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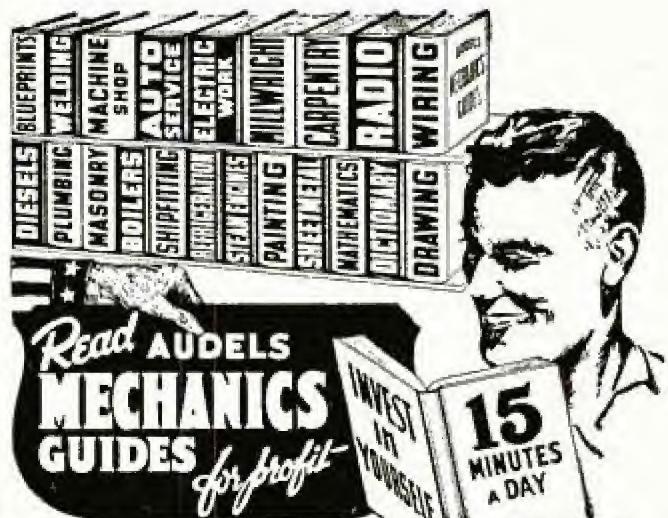
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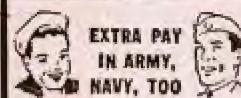
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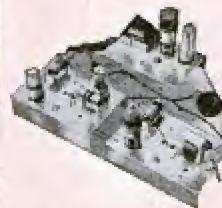
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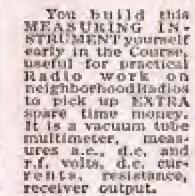
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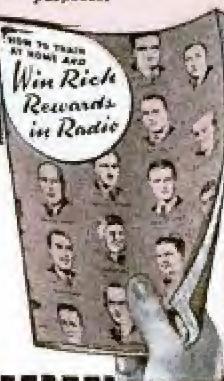
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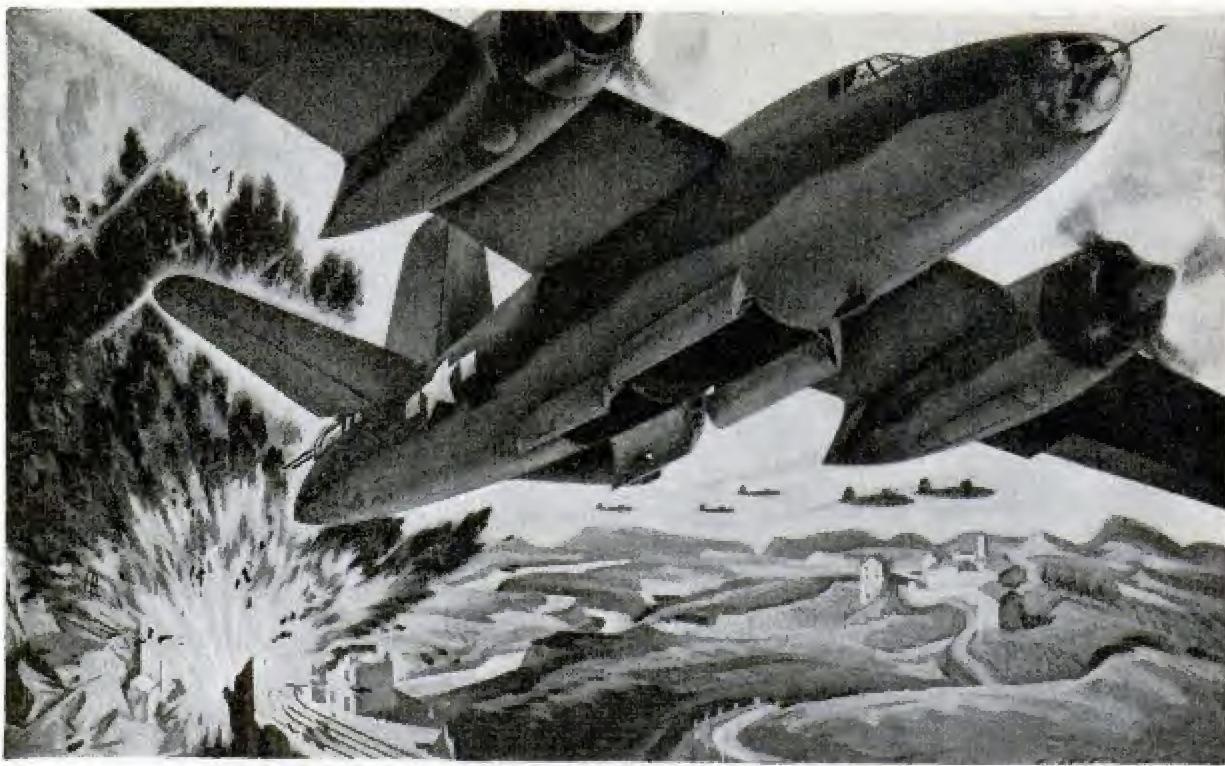


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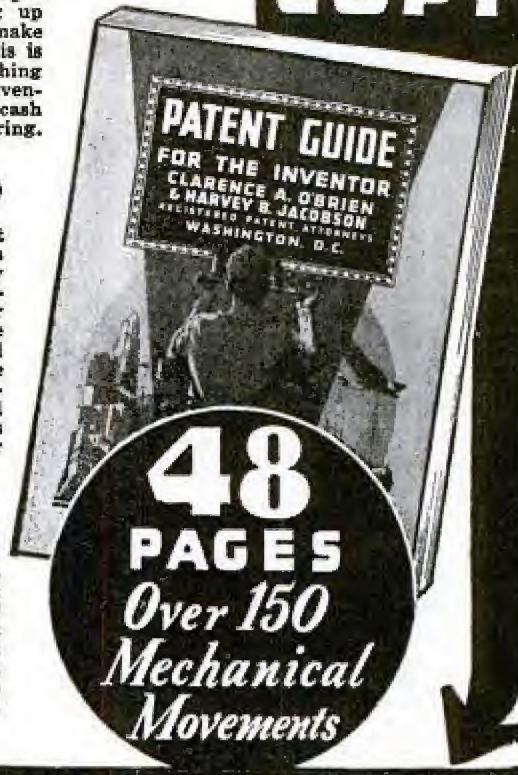
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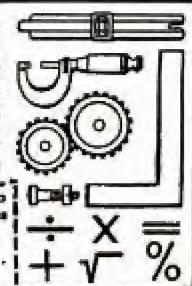
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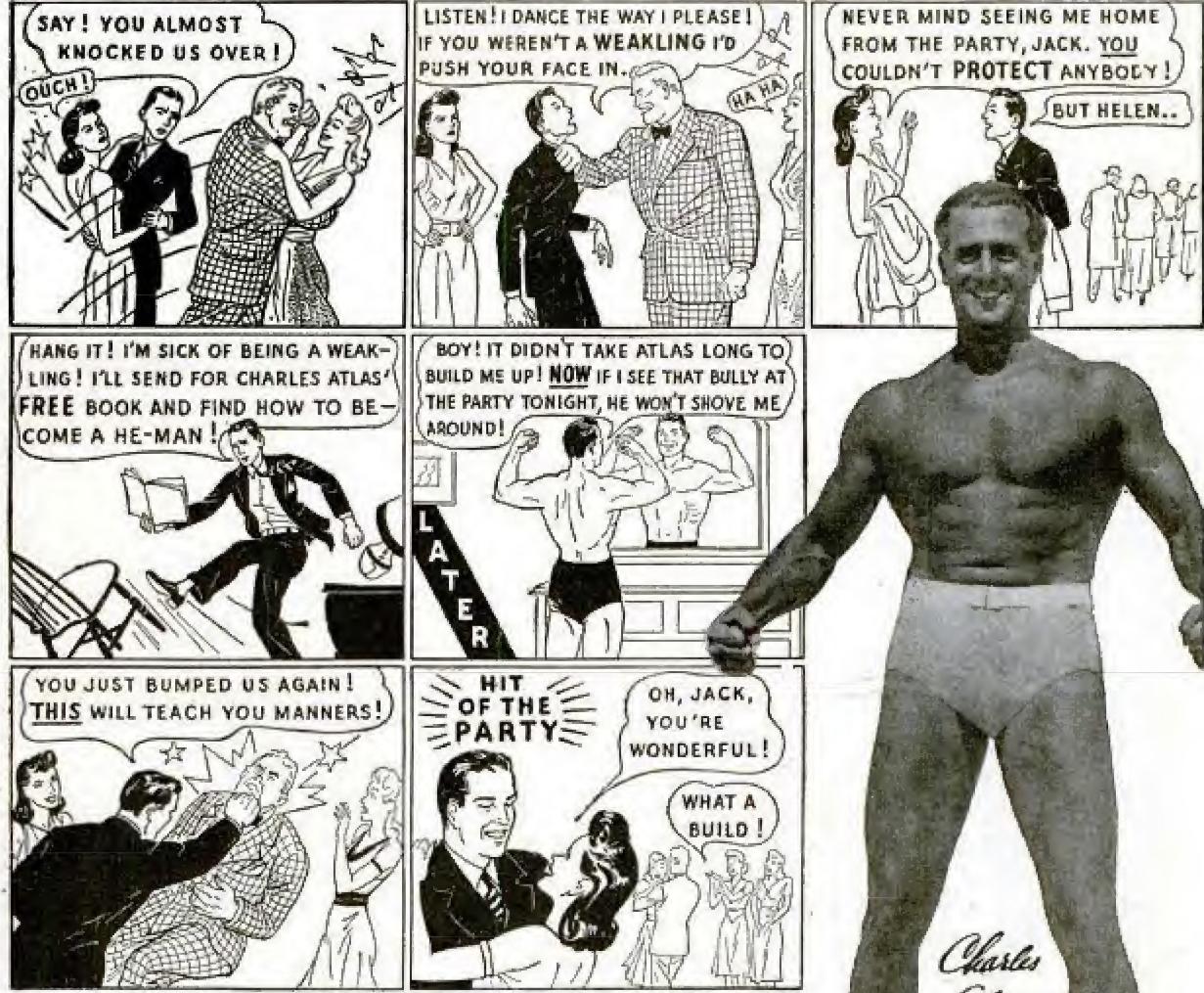
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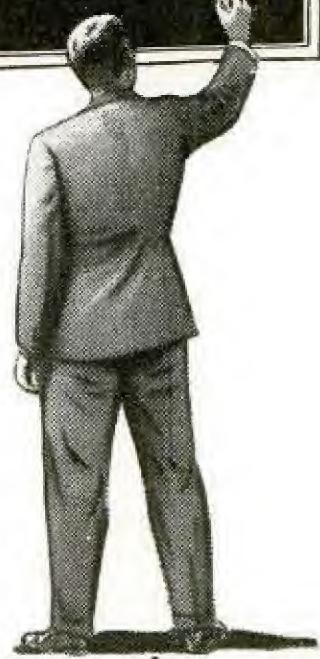
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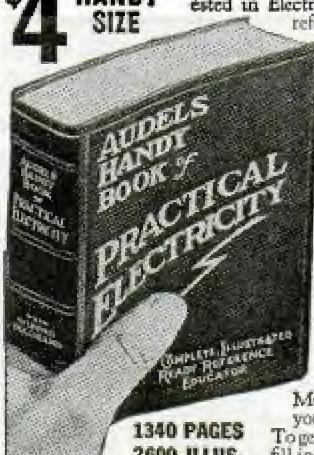
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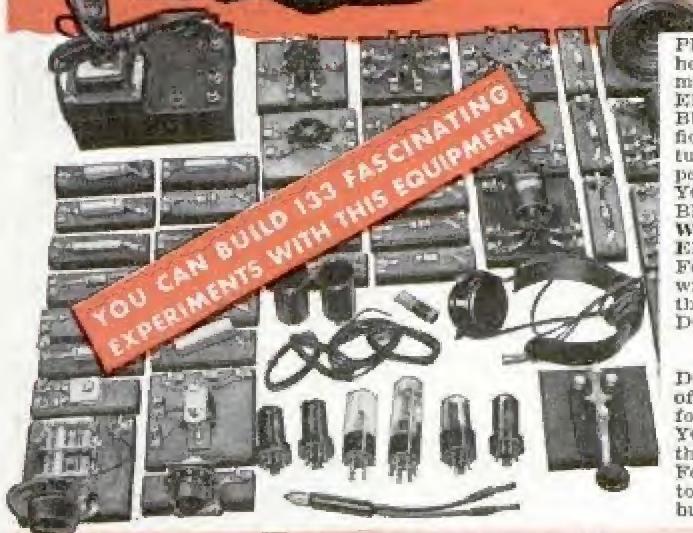
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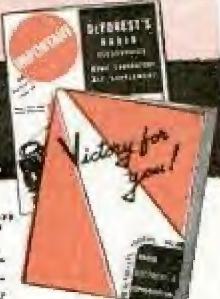
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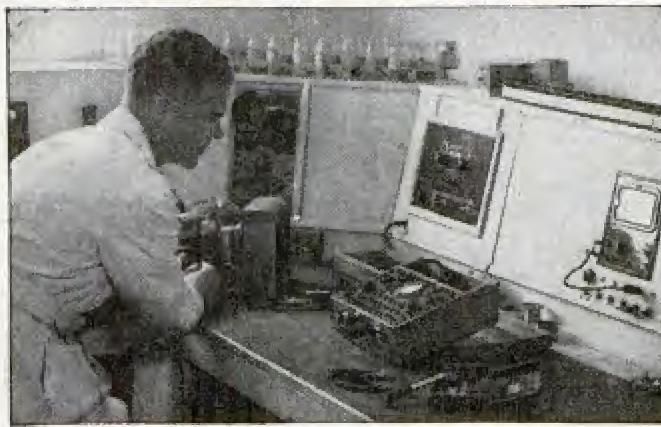
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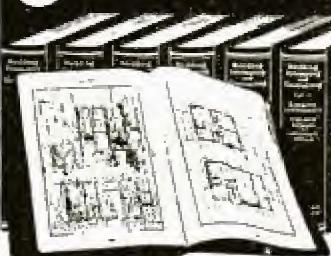
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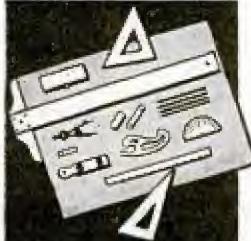
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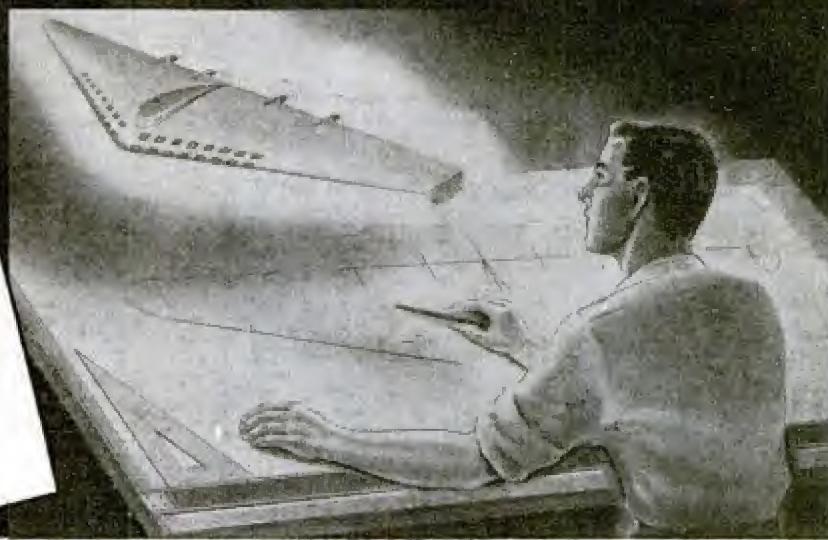
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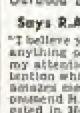
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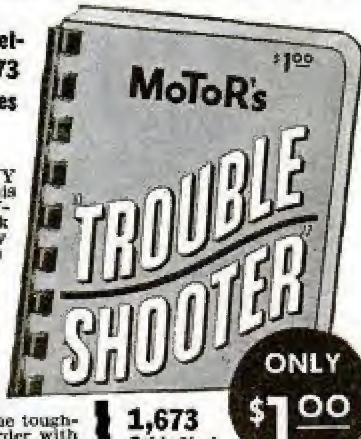
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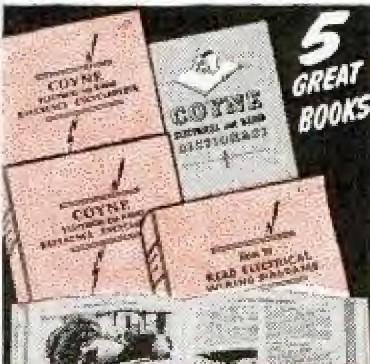
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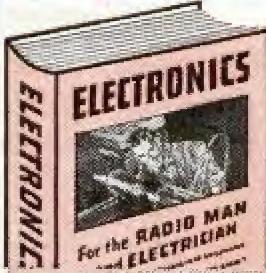
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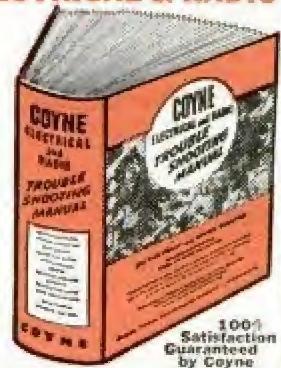
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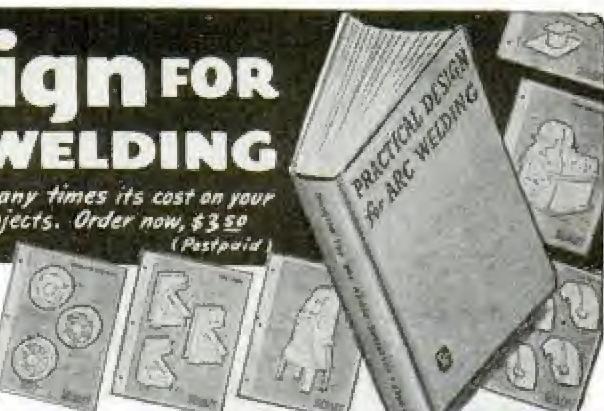
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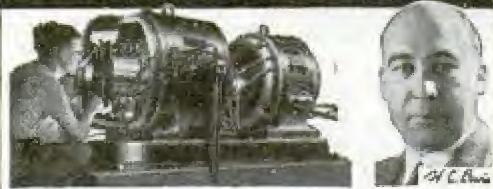
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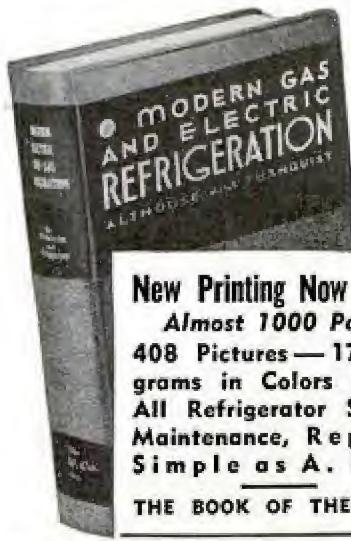
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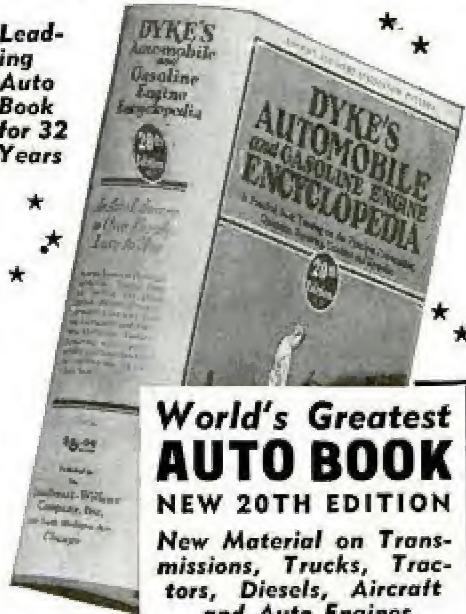
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WE Pay top prices for used cameras and photographic equipment. Turn your idle camera, enlarger, printer, lenses, developing equipment, etc., into cash. Just send us a list of what you have. State make, model, age, condition. We will write you at once, telling you what we'll pay. Prepare your list today. Send to Central Camera Co., (Photographic Headquarters since 1899), 230 S. Wabash Ave., Dept. E-162, Chicago, Illinois.

CASH! Spot cash for cameras, lenses, binoculars, movie or still, sound projectors. Send full description by mail, or wire for prompt cash offer. Over 30 years of dependability insures honorable dealings. Bass Camera Company, 178 West Madison Street, Chicago, Illinois.

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VELOX Deckle reprints 2¢. Rolls developed, two deckle edged prints each negative, 25¢. Two 5x7 enlargements 25¢. Summers Studio, Unionville, Mo.

EVERY Picture an enlargement! 8 sparkling deckle-edge enlargements and roll developed 25¢ coin; 116 size or smaller; enlarge reprints 3¢. Enlarge Photo, Box 791D, Boston, Mass.

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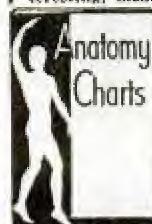
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MAY, 1944

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IT WORKED! No boy had ever seen a more beautiful sight.

Over a little dam spilled the water of the country ditch. The homemade water wheel began to turn on its rake-handle shaft. Faster and faster it went. Next step was to connect it to an old coffee mill inside the woodshed.

Pebbles were poured into the churning mill. They sparked and crackled like a Fourth of July display, grinding noisily into sand to be used later for a casting mold.

Here was the first moving device created by Henry Ford!

Meantime, somewhere inside

his inquiring mind, a dream was struggling to shape itself. A dream of other wheels that would one day turn to lighten the burdens of farm and industry . . . to change the habits of the nation.

From water wheels to watches, to steam engines, to gasoline engines, Henry Ford's interest in wheels progressed. And the rest is history—the history of the automobile industry.

From May, 1895, when the first Ford car was wheeled into Bagley Avenue, Detroit, more than 30,000,000 Ford-built cars

FORD MOTOR COMPANY

and trucks have been produced.

Yet the thought and spirit that prompted that experiment with the water wheel have never changed at Ford Motor Company. There is still the same ingenuity that is not afraid to be original . . . the wanting-to-find-out-for-one-self that makes for progress.

Today, this philosophy and the skills developed through more than 40 years are being applied to America's vital needs. From this will arise new techniques to serve the nation when Ford resumes production of sturdy, comfortable transportation, priced within reach of the greatest number. As Henry Ford has said: "Our times are primitive. True progress is yet to come."



Popular Mechanics Magazine

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0 77

No. 5

Vol. 81

MAY, 1944

HOW MUCH OIL IS LEFT?



Seismograph apparatus on boat may reveal oil-bearing formations far below this southern swampland

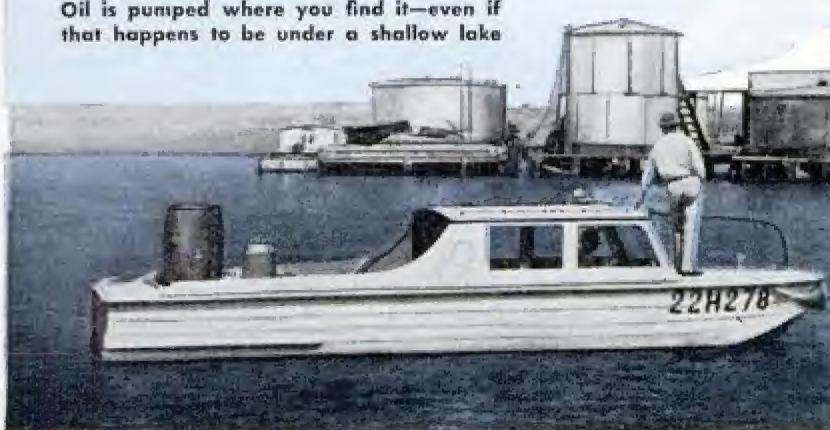


By Wayne Whittaker

IN THE FACE of ominous warnings issued to oil users, the average American wants to know: Are we really running out of oil? His worries are increased by reports that last year our wells produced in excess of 4,000,000 barrels a day to meet the increased demands of war. He has been told the annual production of crude oil was about five times greater than the oil discovered in new fields and extensions of old ones during 1943—an alarming threat to our known oil reserves which are estimated at 20 billion barrels.

While the American oil industry is busy helping keep the Allied war machines powered and lubricated, Mr. and Mrs. America are

Oil is pumped where you find it—even if that happens to be under a shallow lake





Courtesy of The Pure Oil Company

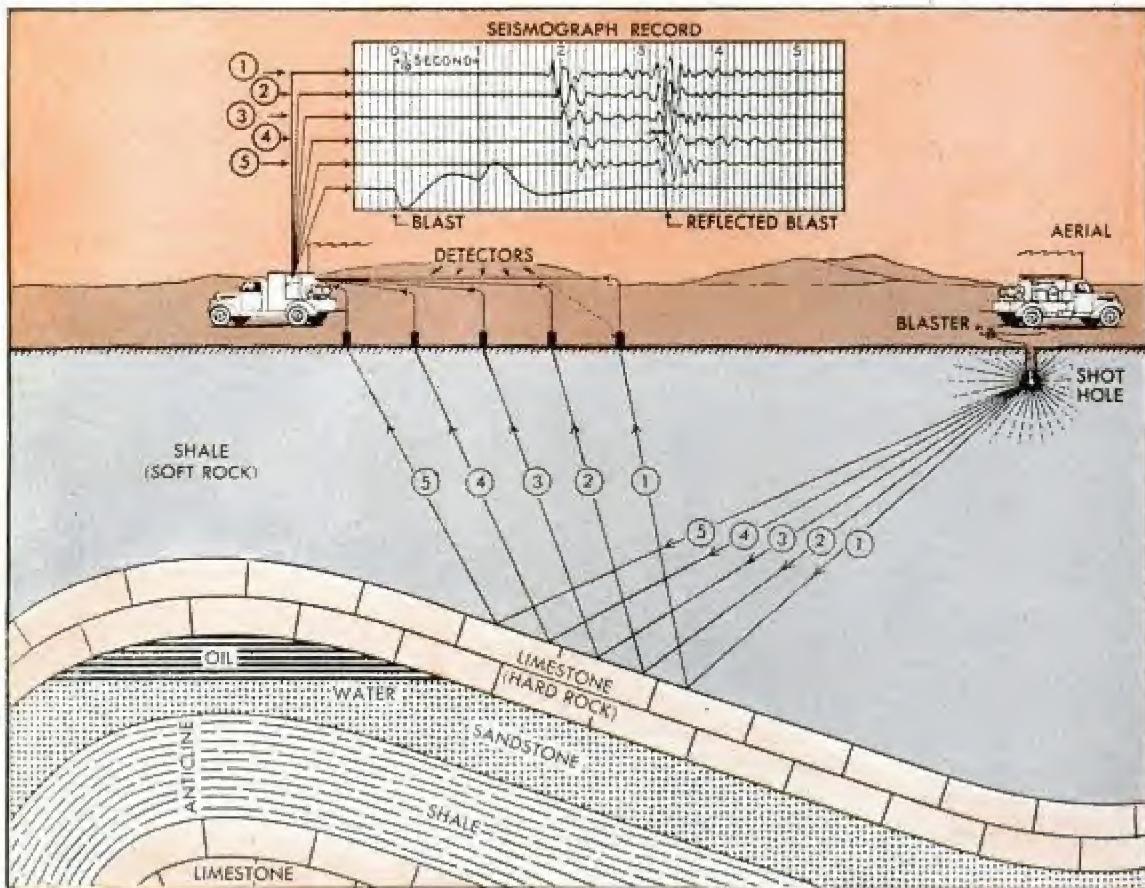
Kneedeep in swamp, surveyor records findings in hunt for oil along the Gulf Coast. Headnet helps fight mosquitoes. Below, drawing shows how seismograph helps find oil "traps"

wondering if we will be running short of petroleum in 10, 15 or 50 years.

What will we use for power in our automobiles, trucks and airplanes should such a catastrophe occur? The honest answer to the query about how much oil we have left is that no one knows beyond the 20 billion barrel estimate.

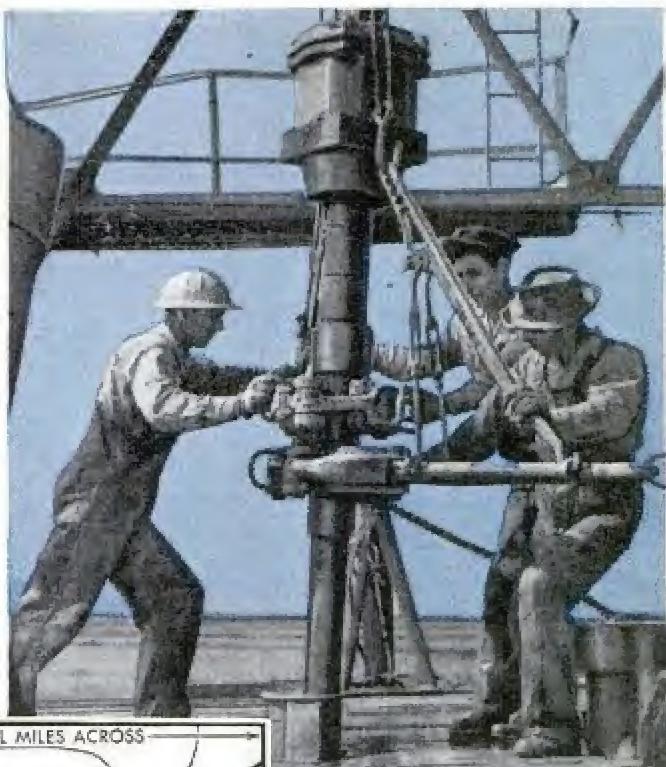
History, however, has a habit of repeating itself. Theron Wasson, chief geologist for the Pure Oil Company and a recognized authority on oil reserves, finds reassurance for apprehensive Americans by turning the pages back to 1921. He points out that published reports of the American Petroleum Institute show that in that year geologists and engineers made a report to the government estimating our known reserves at 9 billion barrels. From 1921 to the close of 1943 more than 22 billion barrels of crude oil have been produced within the United States. And today we have assurance that a minimum of 20 billion barrels more exist which can be recovered by known methods.

Correcting these recoverable re-



serves backward, we find the reserves in 1921 could have been correctly reported as 42 billion barrels instead of 9 billion. In other words, the 1921 reserves were about four and one-half times greater than the estimate. In 1921 the unknown and undiscovered reserve was 33 billion barrels.

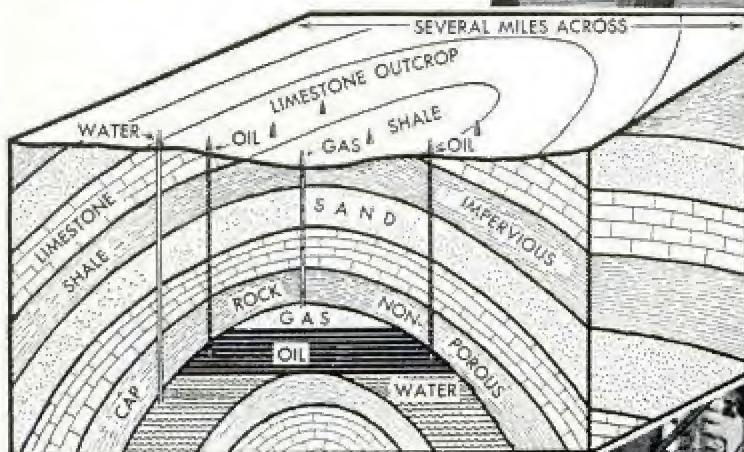
How far wrong is the 20 billion barrel estimate of today? Probably it is less in error than the estimate of 1921, for since then many prospective oil producing areas have been completely drilled up. There is, however, a safety factor in that we still have new territory to explore where deeper oil producing sands will certainly be found. But the fact remains that beyond the 20 billion barrel recoverable reserve which has been proved by drilling we do not know how much more oil there



Drill crew making a connection during operations on new field

Cross-section shows why some wells produce only water or gas

Below, precision distillation column in a petroleum laboratory

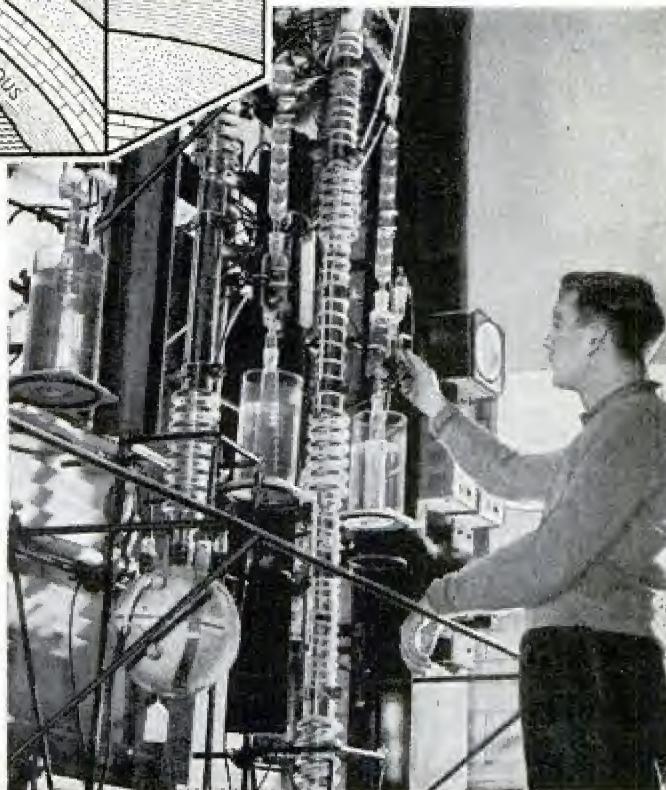


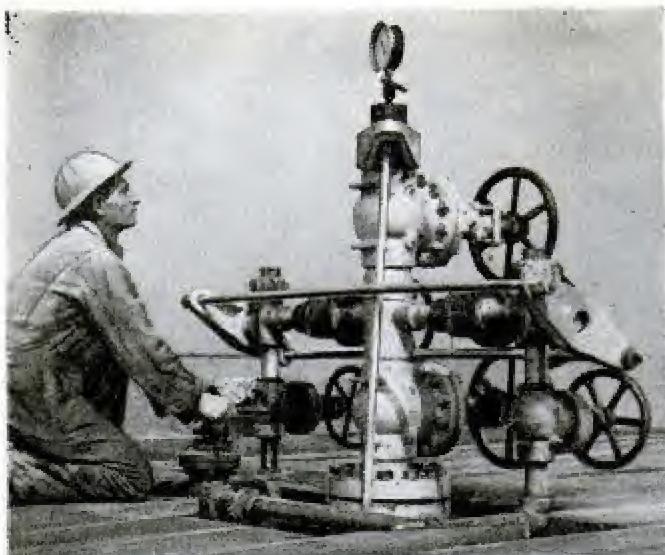
may be left for future discovery.

Today, before prospective oil areas are drilled, a great deal of preliminary geological work is desirable. Surface and sub-surface geology, core drilling, microscopic study of rock samples, electric logging of wells drilled, geophysical instruments—these are the tools of the modern oil prospector.

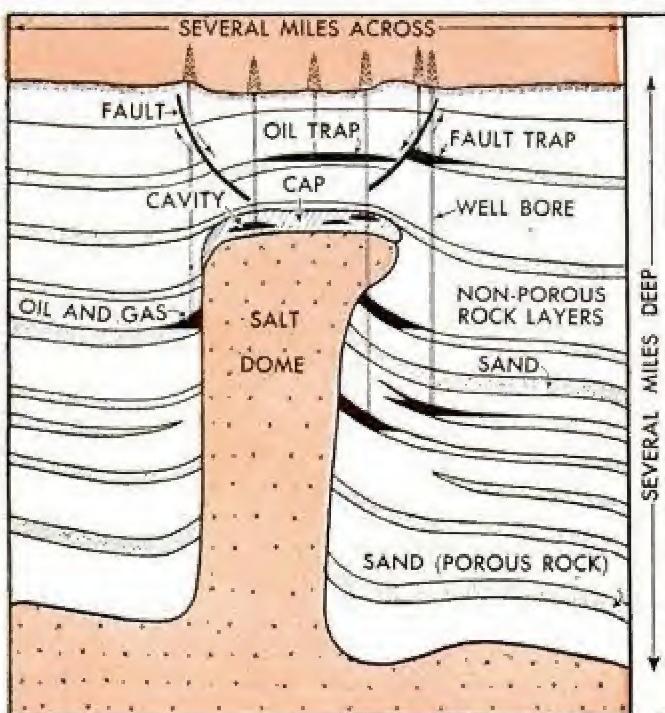
"The geologist does not locate oil," Mr. Wasson pointed out, "but from his studies of the rocks he determines the most likely places to drill. The drill alone determines the existence or nonexistence of oil. Today geologists are searching for new fields in previously un-drilled areas, and it is certain that new fields will be found."

"Something like a billion and a half barrels of crude oil came out





Pumper keeps sharp eye on pressure gauge of oilman's "Christmas tree." Below, upthrust of salt dome forms trap in rock



of the ground in the United States during 1943; more strictly speaking, it came out of the rocks. Crude oil is found in porous rock layers that were laid down long ago in salt water seas. Many people think of oil as existing in lakes, rivers, or caves under ground. This is not true. It is held in the pores or openings between the grains of rocks. The tendency of oil to float on water causes it to rise to the highest available point in water-soaked rocks. If natural formations prevent it from es-

Drilling a new well in the race to keep U. S. wartime oil production in excess of 4,000,000 barrels daily

caping, it is caught in what geologists call an 'oil trap'."

One type of trap is an arch of rock layers known as an "anticline" with the porous layer overlain by a nonporous layer of shale or limestone. The oil is trapped underneath the crest of the anticline. Oil is also found in connection with salt domes, particularly in Louisiana and Texas, which have pushed upward causing sealing formations that trap oil.

One ingenious way of finding these traps is by means of man-made "miniature earthquakes" in conjunction with the seismograph, an instrument for recording tremors of the earth. These "earthquakes" are created by exploding a small charge of dynamite in the ground. Earth tremors, or elastic waves, caused by the explosion travel in all directions, including downward. When they hit a strata of hard rock a small part of the wave is reflected to the surface. The time it takes a wave to travel to hard rock and back to the surface enables trained men to determine the depth of this layer of rock. Thus, the presence of anticlines and other structures favorable to oil deposits is discovered.

Secondary recovery of oil from "exhausted" pools, which are yielding millions of barrels of



crude, must not be omitted from a study of oil reserves. One process consists of drilling "five-spot" wells in old fields. Squares are laid out and holes are drilled in the four corners. Water is pumped into the corner holes which forces the oil to the center of the square where oil is pumped from a fifth hole. This method has proved highly successful in a Pennsylvania field.

"Geologists are sometimes asked why they don't drill deeper if they want to increase our oil supply," Mr. Wasson said. "Although modern equipment makes it possible to drill at depths as great as 15,000 feet, that is no assurance oil will be found."

Beneath the upper layers of limestone, shale, earth and other materials one finds granite. It is futile to drill for oil below granite, for oil-containing formations have never been discovered beneath it.

Back in 1915, wells of 2,000- and 3,000-foot depths were considered deep holes. Today in Texas and Louisiana production is often obtained below 13,000 feet. The deepest hole was drilled 15,004 feet in central California, but no oil was found at that depth, and it was cemented off at about 13,000 feet where oil had been struck.

Another important factor to be considered is the oil reserve owned by American companies outside of the United States. This tremendous source of oil is not included in the 20-billion-barrel estimate.

The nearest large foreign reserve—which was discovered by United States geologists and developed by American companies—is in Venezuela. Ocean tanker distances from New York to the oil fields of northern Venezuela and to the great tanker ports of Port Arthur and Galveston, Texas, are about the same. Venezuela reserves are estimated in billions of barrels.

Another South American neighbor, Colombia, also has rich fields that are being developed by American oil companies. Great reserves are to be found in the Near East—Iran, Iraq, Arabia—and in Russia. The Iran fields are mostly under British control, but United States companies have large interests in Iraq. Russia's oil reserves are unknown, but probably vast.

The Dutch East Indies, now held by the Japs, have large reserves. The Canadian reserves are small, and leading geologists doubt whether the tar sands there will be fully exploited for many years. The widely publicized Canol project near the Arctic Circle is now getting into production with 26 shallow wells and a 600-mile pipeline.

No one can say just how much these foreign oil reserves would mean to America in a pinch. It is one of the problems that will probably confront the peace table.

Continued to page 160

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To help train Navy navigators for global warfare, large-sized plaster globes have been developed. Chalk can be used on the blackboard-like surface to trace navigation routes. The globes have a tolerance of 1/3000 inch in manufacture, to allow almost perfect alignment of country boundaries.

Don't Waste "Wastepaper"

THERE'S no such thing as wastepaper. Paper is precious. When you waste, burn or otherwise destroy even a scrap of it, you are destroying part of the pattern of victory. This magazine, like all others, like your daily newspaper, has reduced its production to save paper for vital war purposes.

Bundle up the paper from your wastebasket; tie up old magazines and cartons and newspapers. Sell it to a wastepaper dealer, give it to your favorite charity or call the local salvage committee. The shortage of paper is grave. Don't waste wastepaper!

O 17 RCAF Brings Bombers Back From the "Bush"



More than one bomber of the Royal Canadian Air Force now flying out over the Atlantic on coastal patrol has been salvaged from the wild "bush" country after a forced landing. Bringing 'em back to fly again is the difficult job of the RCAF's "salvage department." A typical case was that of a \$250,000 Ventura bomber forced down on the ice of a wilderness lake by engine trouble and bad weather. The five-man crew was rescued by a plane equipped with skis. Then an air force rescue crew with the aid of army engineers hewed a trail from the lake through virgin bush to the nearest road 14 miles away. To save the valuable bomber from sinking through the ice into 23 feet of water, poles made from 56-foot trees were sunk in the lake bottom. The bomber was roped to the poles and floating wooden platforms were built. The machine gun, gun turret, wings and engines were removed and hauled across the lake on sleds. Trucks carried the parts out over the new road, which took five weeks to build, and the fuselage was attached to a bulldozer and moved inch by inch out of the wilderness. On the way it nearly slipped over a cliff and was saved by the quick thinking of soldiers and airmen. Once out of the bush, the aircraft was trucked to the nearest airfield where it was re-assembled and was soon back on patrol. Recently a Canso amphibian loaded with depth charges was salvaged in rough seas off the coast of Newfoundland where it sank. It was grappled for and brought to the surface without exploding the charges. A Hudson bomber forced down on a mountainside was salvaged by removing the engines and lowering the plane down the mountain to an ice-covered lake where the engines were refitted so the plane could take off on its own power.

RCAF bomber forced down on melting ice of wilderness lake was brought back in pieces and flies again on Atlantic patrol. Third photo shows bomber roped to poles to keep it from sinking. Bulldozer hauled the fuselage through the bush

Art: Mr. James Montague
1/17 colorized, Commissioned
from the Original Drawing
by the Canadian War Photo
Unit

Winged Bikes Teach Cadets Flight Formation

Canadian air cadets at one training center learn to fly in formation on bicycles fitted with wings and tail assemblies to resemble British Spitfires. The students are divided into two flights of six each, and they are taught hand and voice signals. Bicycle formations include V-formation of two flights, one be-

Right, Canadian cadets on the "flight line." Below, practicing V formation



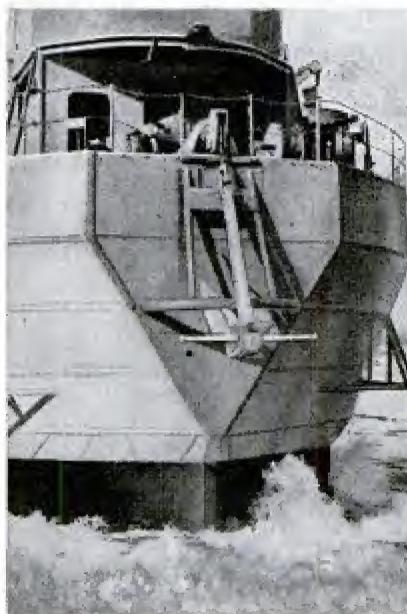
hind the other; echelon left and echelon right, line astern and line abreast. In experiments conducted at the Fingal, Ont., bombing and gunnery school, each flight

was led at the beginning by an experienced pilot. After the cadets learned the various formations, the best man in each flight was chosen as permanent leader.

77819

"Plow" Anchor for Landing Craft Helps Barge Off Beach

Oceangoing LST's (Landing Ship, Tanks) are equipped with anchors which prevent the boats from swinging in toward shore and also help the vessels get off the beach. The anchor, which is dropped astern, has flat pointed "flukes" that dig into the ground. By reeling in on the anchor after the barge is unloaded, the boat is eased away from the beach. The 328-foot LST requires a 3,000-pound anchor of this type, but one of conventional design would have to weigh 5,000 pounds. Similar anchors are used on Navy and Coast Guard craft.



Anchor and reel ride stern of barge; closeup shows "flukes" that dig in

MAY, 1944

R. S. Danforth
2121 Allston Way
Berkeley 4, Calif.

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7958

OUR BULL'S-EYE BOMBARDIERS



The bombardier's work starts an hour or two before the plane takes off. He checks the bombs and their fuses in the bomb bay and inspects the big blockbusters that are carried outside, attached to the wing. He makes pre-flight checks of his instruments. He attends the briefing at which he is told the name and location of the bombing target and the direction from which to approach so as to encounter minimum antiaircraft fire. Air intelligence gives him maps and photographs of the target area so that he will be able to distinguish the target in spite of its camouflage and won't be fooled by a dummy target a few miles away.

En route to the target, he has multiple duties. He is the gunner who must ward off enemy aircraft that attack from head on. He is concerned with pi-

Left, student bombardier watches for target on night practice mission. Below, his front seat in the nose of a Flying Fortress

FROM the time the bombardier lines up the cross hairs of his bombsight with the target and then sets the trigger, the results are practically inevitable. At that moment the huge bomber becomes a mechanical robot that could complete its purpose without human supervision.

The crew could vanish and still the plane would maintain its course, the bomb release would operate at the correct instant, and the bombs would hurtle down on a collision course with the target.

America's famous bombsight is a mechanical and electrical automaton. The bombardier gives it the information it needs and the sight does the rest. Coupled to an automatic flight control device, it takes charge of the plane, flies it to the mathematical point in space at which the bombs must be dropped if the target is to be hit, and drops them.

This is the sight that has the reputation of being able to drop a bomb into a pickle barrel from 20,000 feet. That is an exaggeration, of course, yet it is the reason why American pinpoint bombing of enemy targets has been so successful.



lotage, checking ground points to make certain the bomber is on course. Often he is the plane's doctor, in charge of first aid for the wounded. He keeps track of the weather so that he can give the information to the base forecasters. He may be in charge of the blinker gun for signaling other planes in the formation and for exchanging recognition signals.

Meanwhile he is preparing his own instruments. He makes observations through the drift meter so that he can compensate for side winds. After the final altitude is reached and no more changes in temperature are expected he begins to set into his bombsight some of the data it needs.

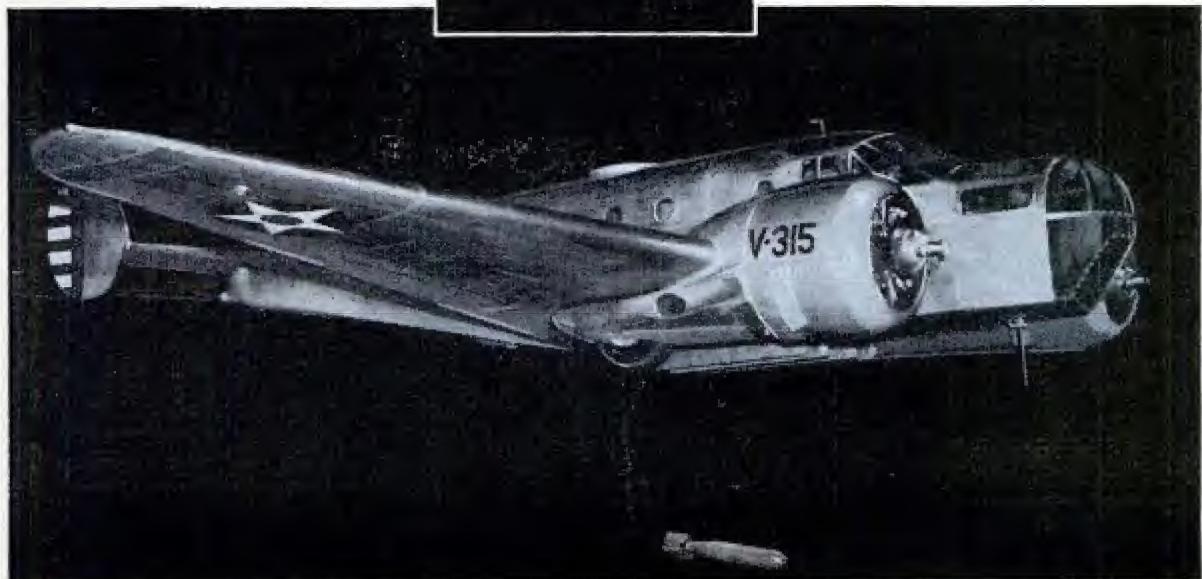
He turns one wheel to the bombing altitude, which is the altitude above sea level from which the bombs are to be dropped minus the altitude of the target. He turns a dial to the desired dropping angle, which depends on the weights of the bombs and hence their trajectories. He feeds into the bombsight the plane's true air speed and its drift. On an intervalometer panel he marks



Here's the bombardier's-eye view as he makes the target run. Notice target "X"

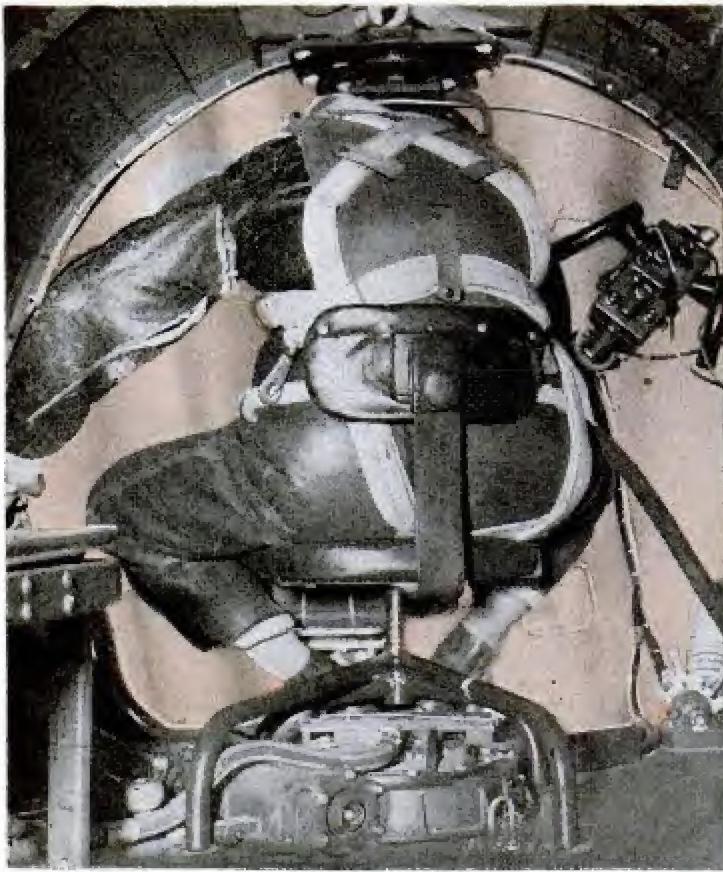
Bomb away! Through bomb bay doors the practice egg falls toward target

Here a flash from a companion plane catches bomb at moment of release





Smoke rises from phosphate works and air field on Jap-held Nauru Island as a B-24 Liberator turns homeward. Below, bombardier on his "office chair" crouches over bombsight of a Flying Fortress



out the particular bombs that are to be dropped and their rate. This is based on the distances apart at which they are to land.

The bombardier takes complete charge as the target is approached. He locks in his automatic flight control that flies the plane far steadier than could a human pilot. Every inequality of the air, even the gusts from nearby anti-aircraft shell explosions, are countered by the servomotors so smoothly that the plane moves steadily and inexorably on its course.

The bombardier pulls the lever that opens the bomb bay doors, then another lever that arms the bombs, freeing the spinners on the fuses. The plane is moving straight toward the target and the bombardier turns the telescopic eyepiece of his sight until its cross hairs are on the target. He pulls another control that clutches in the mechanism of the sight, setting it in operation, and locks on the bombing trigger.

This is the point at which

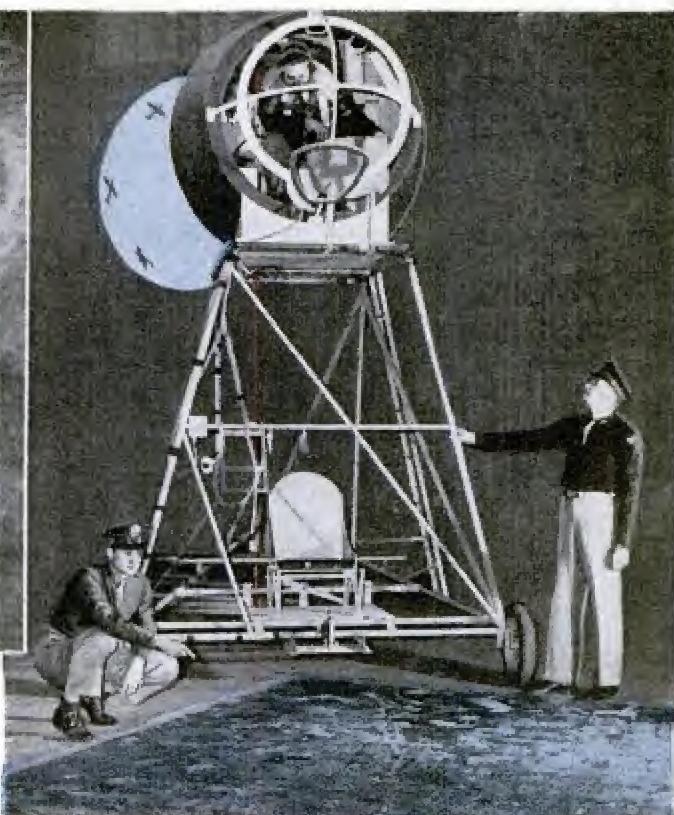


Setting instrument dials on target run

the bombardier could turn the whole operation over to his instruments. The bombsight will keep a steady watch on the target without his presence. The rate of approach has already been determined and the bombs will be released when the dropping point is reached.

Actually, the bombardier stays at his post. He is concerned now with final minute corrections that, from possibly 30,000 feet, will guarantee bull's-eye bombing. He watches a couple of bubbles on the bombsight so that he can compensate for tiny deviations in flight, keeping the plane exactly parallel with sea level. He is still absorbed in this task when the indicator lights flash on; the bombs are on their way.

This description doesn't begin to tell of the difficulties of a bombardment flight. Enemy fighter planes may have been charging in; antiaircraft fire may have been so bad that violent changes in course were necessary up to the time the bombing run was started. The bombardier may find the target so well camouflaged that he must make another run. After dark it is worse. The target is hard to find even with the aid of flares, and it may be obscured by clouds of smoke from smoke pots. Enemy search-

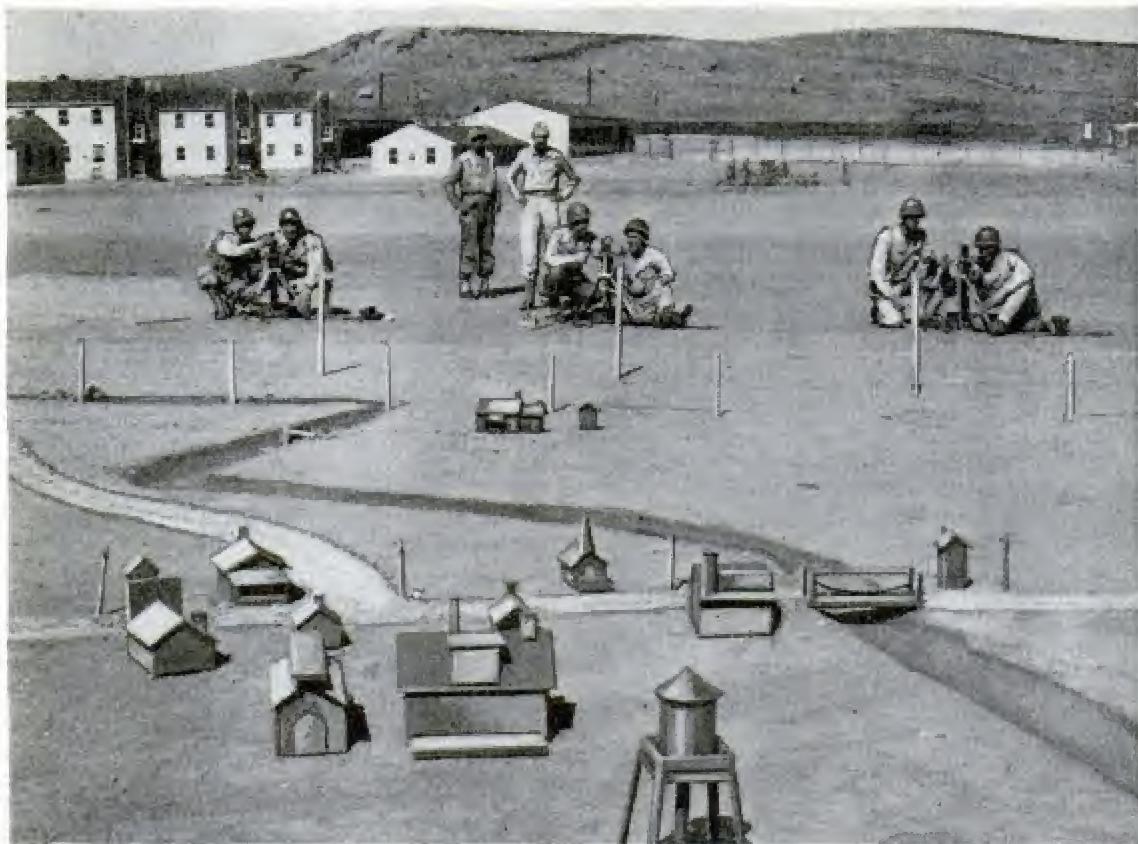


In a mockup of his flight quarters, a student bombardier makes a "bombing run" over a mosaic map of enemy area. Below, the spinner and fuse in nose of a bomb are inspected before flight



Continued to page 160

Mortar Crew Shells Tiny Town With Marbles



Members of Company E of the 66th Infantry at Camp Carson, Colo., learn the correct use of the 60-mm. mortar with a miniature village for the target. The shells are marbles "fired" with a spring inside imitation mortar shells made of wood. After the spring is set, a marble is placed on top of the shell which is then dropped

down the gun. The spring is released by means of a ring that is part of the shell, and the marble shoots out in an arc similar to that of a real shell. The gun is set just as if live ammunition were being used with the exception of range which is judged on a proportionate basis. After practice, repairs are made with wood and paste.

"Stars" in Dome Over Trainer Are "Shot" by Navigator



Student crew on "bombing mission"; trainer can spin or hold the course

Conditions encountered on actual bombing missions are simulated with a celestial navigation trainer which accommodates pilot, bombardier and radio operator as well as the navigator. The trainer, which never leaves the ground, is suspended in a framework which enables it to turn, spin, or hold the course. Pinpoints of light in a revolving overhead dome represent stars which are accurately placed so the navigator can take a reading with his sextant. Beneath the trainer is a screen on which is projected a movie of passing terrain, and another projector shows cloud formations. An instructor under the trainer assigns problems and synchronizes the stars. The trainer is air-conditioned to protect the instruments.



AAF "Skip" Bombers Sweep Over Treetops To Score Bull's-Eye

Skip-bombing, low-level bombing, or "masthead-height" bombing are all different descriptions of the same technique, an American-invented method of hitting the bomber's target with a minimum of risk to the plane and the maximum chance of a score. Planes with terrific forward firepower are used, to blast at the enemy's antiaircraft gun crews while the bomber is lining up for its run on the target. Most sensational achievement of skip-bombing was the decimating of the Japanese invasion fleet in the Battle of the Bismarck Sea. In that and similar bombing forays, use was made of the fact that a bomb, dropped from a low level on the water, hurtles forward, much as a stone thrown across the surface of a pond. But the same technique works on land. In the assault on Pantelleria, one American pilot "skipped" a bomb inside an underground hangar, creating havoc within. Skip-bombing crews, trained in an area of Florida roughly the size of Sicily, fly in for their bombing runs at altitudes as low as 50 feet, and it is their standing joke that "when we fly above 150 feet we are so unaccustomed to the height that we have to use oxygen." The planes hug the terrain, rising over the ridges, and swooping down into the depressions. By approaching at minimum altitudes, they frustrate "enemy" plane-spotting devices, and also are upon their targets before anti-aircraft gun crews can bring their guns to bear. By releasing their bombs about 300 feet from the target, they take advantage of the bomb's "skip," and by using delayed-action bombs the planes can be out of the danger area from the ensuing explosion before the bomb goes off. The "skip" bombing pilots race in over their targets at a speed in excess of 200 miles per hour. At the Army Air Forces Tactical Center, with headquarters at Orlando, Fla., squadrons of A-20's almost clip the tips of the pine trees on simulated bombing attacks.



Army Air Corps photos

MAY, 1944

Mr. J. Newton, 1st Lt. Air Corps
Public Relations Officer
Army Air Forces Technical Center
Orlando, Fla.

71890

FLYING GAS JET



Air compressibility, which becomes manifest at about the speed of sound, affects the propeller "long before the wings of a plane are affected," says Captain Kotcher, in Air



Force. "The jet engine eliminates propellers. It will not eliminate the inevitable effect of compressibility on wings, but since the breakdown of flows occurs on a propeller long before it does on wings, it enables the plane designer to realize the difference in speeds between the points where the propeller is affected and where the wing is affected. This difference may be about 100 miles an hour for the immediate future."

In this country the first flights were made in a twin-

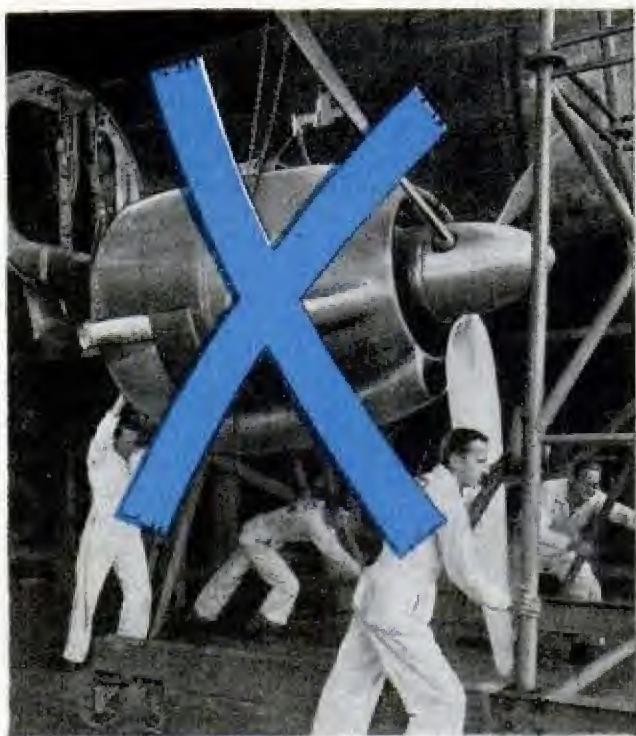
THE FIRST fundamental improvement in flight since the Wright brothers attached an engine and propellers to a glider and rose off the ground 41 years ago is embodied in the jet propulsion airplanes with which the United States has been experimenting for the last year.

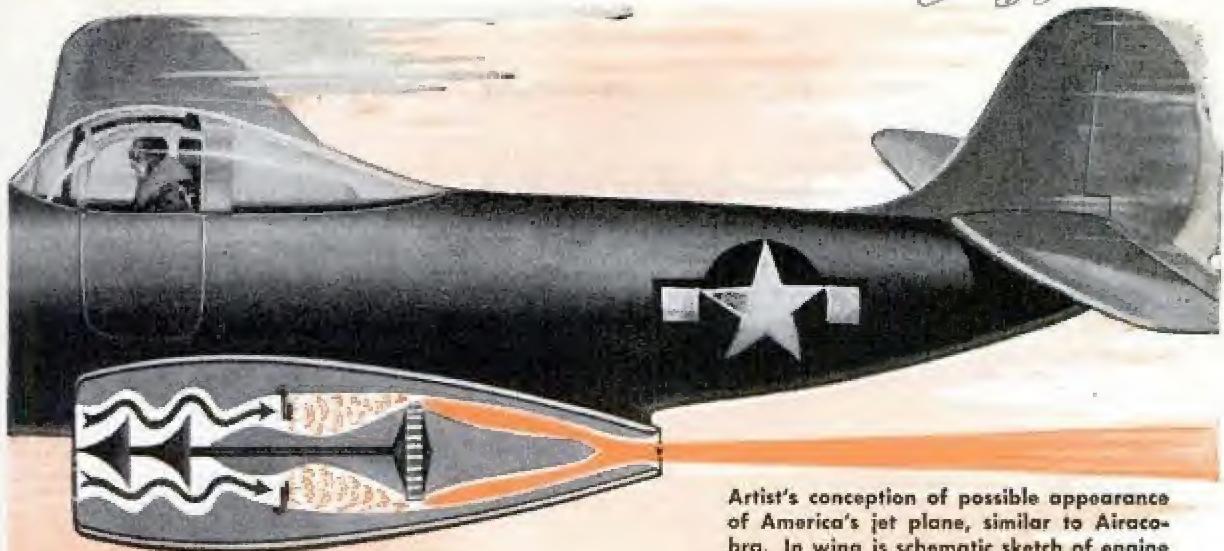
Odd as it seems, today's fastest conventional aircraft are nothing more than improved models of the original Wright plane. Modern aircraft are larger, vastly more efficient; yet they operate by the same means, air screws driven by internal combustion engines.

A jet-driven plane was decided upon by General H. H. Arnold and other Air Force officers "when present planes gave indications they had about reached the limit of performance obtainable by means of propellers," writes Capt. Ezra Kotcher of the A.A.F. Materiel Command in Air Force magazine. "The limit was imposed by the rapid falling off in the efficiency of the propeller when the effects of compressibility set in at extremely high speeds."

The drop in propeller efficiency at high speeds and in thin air have limited propeller-driven aircraft roughly to 500 miles per hour and 50,000 feet altitude.

Above, tail view of Italy's jet plane of 1940. Below, one of four engines of the Constellation. By eliminating propellers, jet plane may add 100 miles an hour





Artist's conception of possible appearance of America's jet plane, similar to Airacobra. In wing is schematic sketch of engine

engined jet plane built by Bell Aircraft, based in part on British developments. The experimental models have top speeds between 500 and 600 miles per hour. Pilots who have flown them can scarcely hear the weird noise of the exhaust and are impressed by the absence of vibration, the smoothness and ease of control. A jet propulsion airplane is simpler to fly than a primary trainer.

"The number of gadgets and dials are cut down considerably from the number in the conventional fighter plane," writes Captain Kotcher. "One throttle does all the work, forward to go, further forward for greater speed, back to slow down or stop. The aircraft is built low to the ground because there is no ground clearance to provide for the propeller."

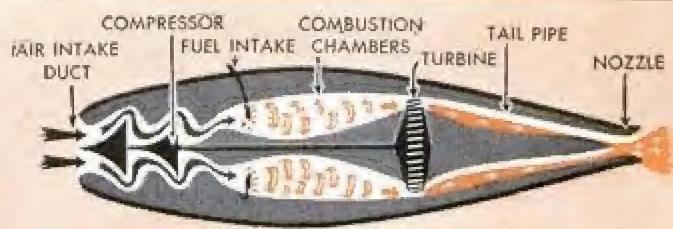
But with little vibration to help tell him how his airplane is handling, a pilot has to dispense with "seat of the pants" flying and depend more on instruments. In fact, it was necessary to install a vibrator on the instrument panel of the Bell jet plane so that its pilots would be assured the instruments were not stuck.

For the time being, it appears that jet propulsion will be most valuable where high speed and fast

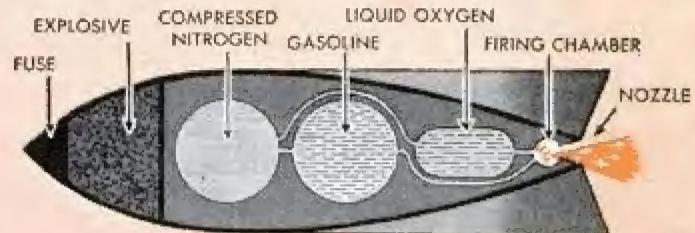
acceleration are more important than economy and long range. Possibly the jet drive eventually will be so efficient it will replace propellers for all types of air travel.

The jet propulsion craft are based on an

Continued to page 162



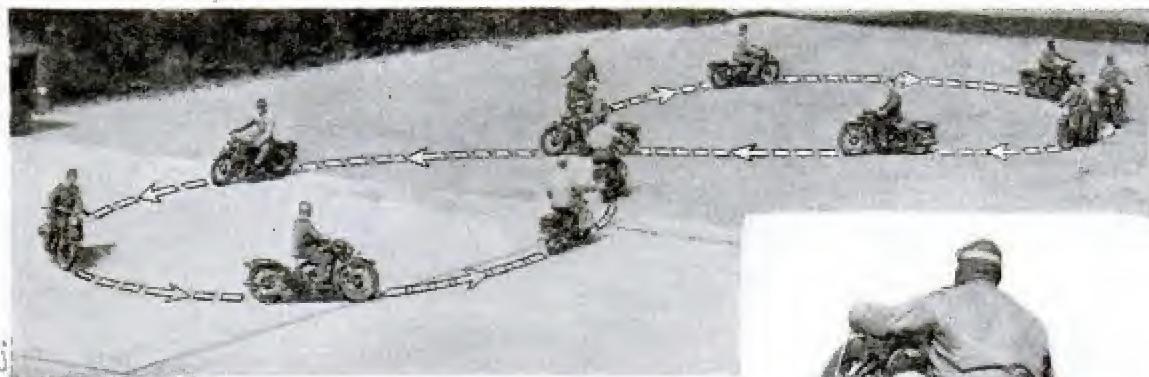
THERMAL JET: This formalized conception by a staff artist of Air Force magazine of a jet propulsion motor is not intended to illustrate mechanical workings or portray any specific engine design. In the thermal-jet system, oxygen is obtained from air which enters intake ducts and is sent by compressors into combustion chambers. Fuel is added to the compressed air and ignited. The resulting gases flow through a turbine, which drives the compressors, and from there to a tailpipe where they are nozzleed down, attaining great speed and forming the propulsive jet



ROCKET: Both the thermal jet and rocket systems get their thrust from a rearward jet which forces the mechanism forward. The rocket contains all the elements needed for combustion. In the example above, compressed nitrogen provides pressure to force gasoline and liquid oxygen into a firing chamber where they ignite, and the resulting high-pressure, high-temperature gas escapes and sends the rocket forward. Many rockets use a relatively slow burning powder instead of liquid fuels. The powder contains the oxygen necessary for burning

Drawings by courtesy Air Force Magazine

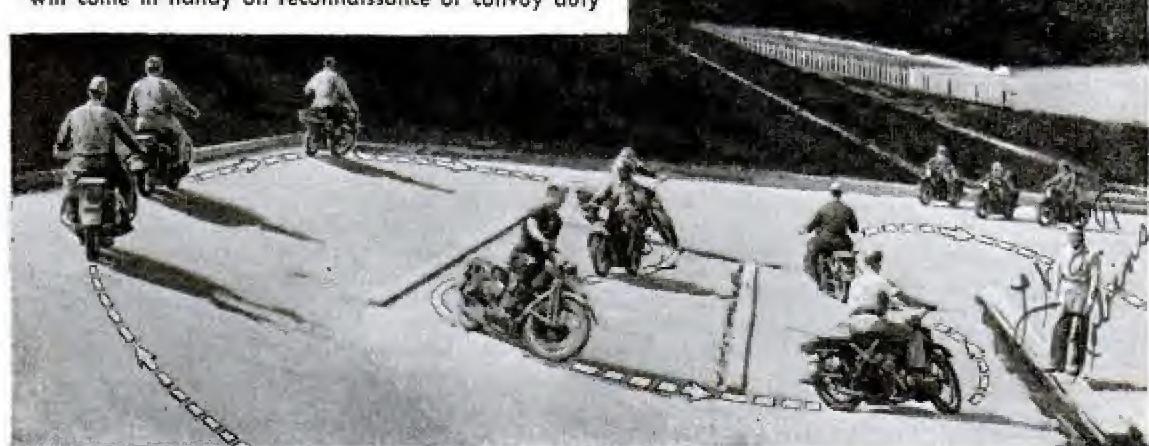
Army Rough Riders on Wheels Set Dizzy Pace



Dodging shell holes, climbing steep embankments, or turning on the proverbial dime to avoid a booby trap are all in the day's work for Uncle Sam's motorcycle soldiers. Above, rookie riders doing figure eight on test course. Right, expert rough rider goes "over the top"



Starting out for road practice at the Holabird Ordnance Automotive School, the men learn hand signals and become experts in precision riding. Below, skill acquired by riding through obstacles on banked hill will come in handy on reconnaissance or convoy duty

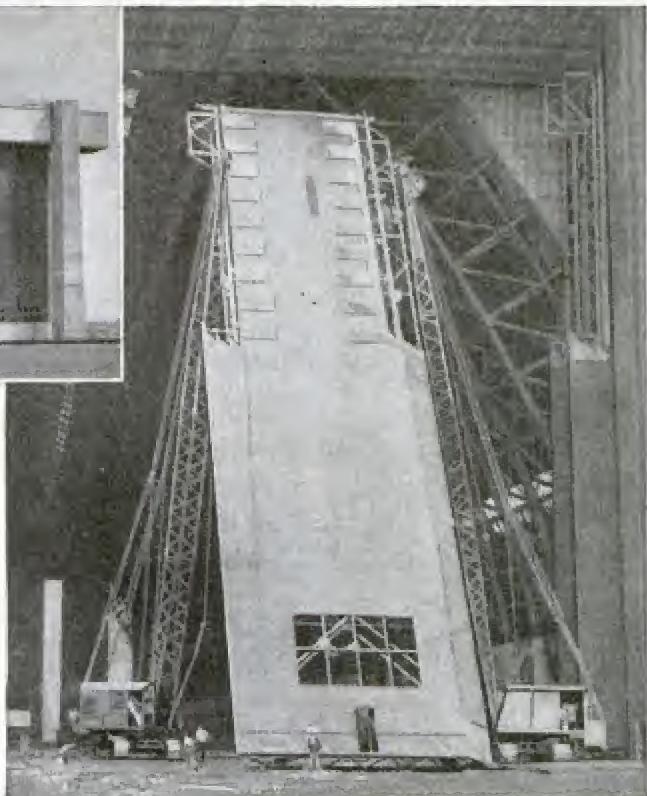


71904

Giant Doors for Blimp Hangar Weigh 240 Tons



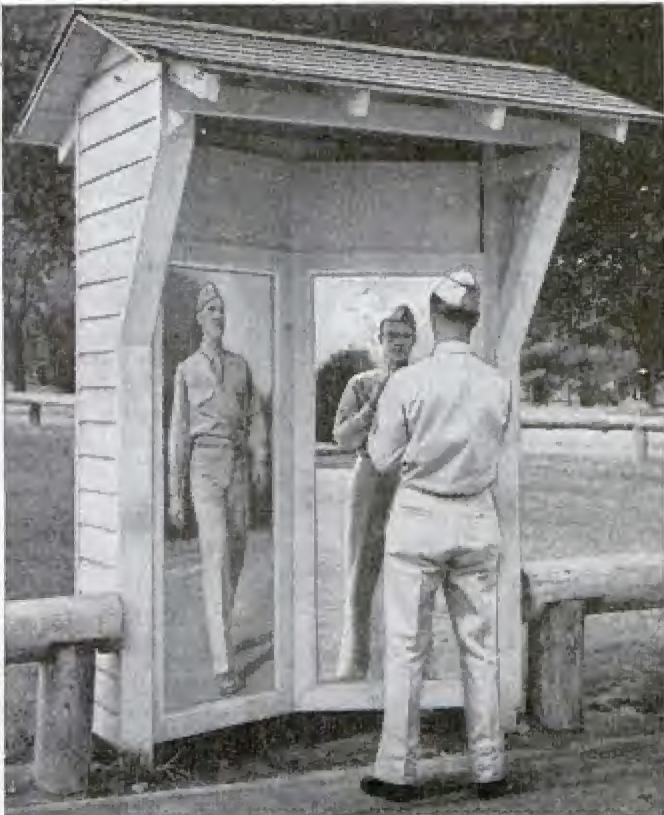
Built in six sections, each of which weighs 40 tons, doors for the Navy's lighter-than-air hangars are believed to be among the largest in the world. The doors are 120 feet high and 220 feet wide, constructed of steel frame faced with wood. When an electric button is pushed, the doors part in the center and the sections move at different speeds to reach the outer edges of the hangar together. Each 37-foot-wide section is erected in one piece. The doors were built by The Ingalls Iron Works Co. of Birmingham, Ala.



Installing one of skyscraper doors in hangar shown at top

71883

"Neatness Mirror" Is Reminder to Yank Leaving Camp



To compare his own appearance with that of the commander's views on how a model soldier should appear, any man at the Quartermaster Corps Replacement Center at Camp Lee, Va., need only step before one of several "neatness mirrors." Thus, soldiers departing on leave may give themselves a last-minute critical look, to discover whether their appearance will reflect credit on their establishment. A full length picture of a soldier properly attired aids in the comparison.

O 80

'Standpipe' in Hull of Mars Helps Balance Its Load

Loading of flying boats is simplified by a weight and balance indicator, installed by Glenn L. Martin Co. engineers on the Mars. A three-inch standpipe in the hull near the bow, and another near the second step, provide readings of draft and trim angle. These are plotted on a chart to obtain loaded weight and center of gravity.

Baltimore, Md. 17

21876

TRUCKING to VICTORY

Day and night a vast tonnage of war material is kept rolling in freight trucks loaded to capacity



14-247-162-St. N.W.

By John V. Lawrence

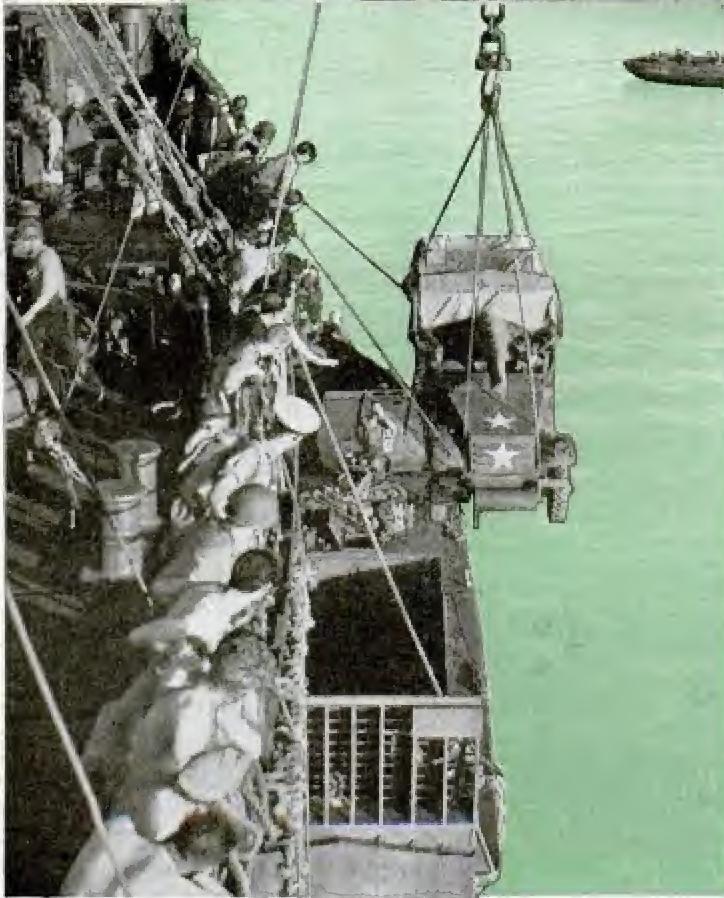
**Managing Director,
American Trucking Associations, Inc.**

Washington, D.C.

THE trucking industry is doing a great job in this war. On the home front it comprises a vast network of thousand-mile assembly lines, rushing parts from small contractors to the final assembly plants. It is trucking's proud boast that with one-twentieth the carrying capacity of the rails, trucks are hauling one-quarter the rail load.

On the battle fronts—the South Pacific, India, Russia, the Mediterranean—trucks are helping the United Na-

Half-track is lowered from warship as marine driver stays behind wheel, ready to roar away from the beach





tions to win by using that war-tried axiom of military success, "getting there fustest with the mostest."

The first motor truck made its appearance in 1902 in Detroit. By 1917, there were about 200,000 of them. World War I was the springboard which started trucking on its way toward becoming a major transportation industry.

Let's look at some of the jobs that America's 4,600,000 trucks are doing to help smash Hitler:

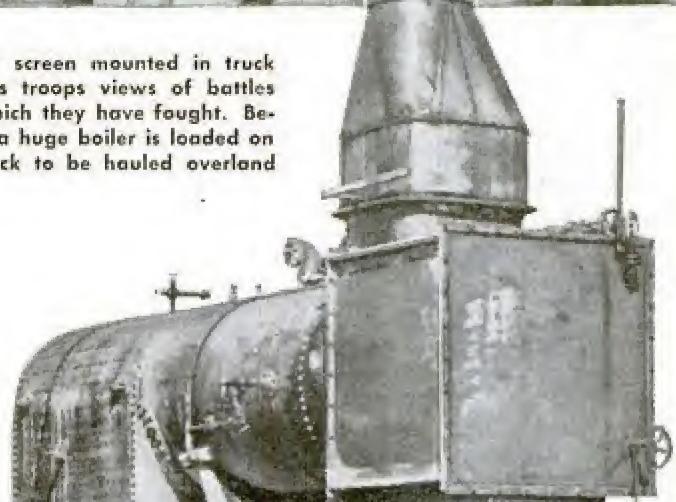
By means of trucks, an automotive prime contractor in Michigan extended his assembly line 125 miles to include facilities of four subcontractors in three other cities.

Close teamwork between steel makers and truck and air transportation recently enabled a factory in England that is making vital tank bearings to receive a shipment of specially treated steel within four days. Trucks rushed the steel from the Middle West to an Eastern wire-drawing plant and then to another plant for heat treatment.

Not long ago an outfit of soldiers had been given



Small screen mounted in truck shows troops views of battles in which they have fought. Below, a huge boiler is loaded on a truck to be hauled overland





One of the military truck's vital jobs—setting up lines for the Signal Corps

hurry-up orders to go from Oklahoma City to Blythe, Calif. But they couldn't operate without rifles, tents, blankets or mess gear. Normal rail time for moving such equipment was seven or eight days. Cain's truck lines took the job and delivered all the stuff in the little desert town in just 41 hours—the trucks arriving an hour before the troop train.

Trucking operators have had to re-design many of their trucks and some of their equipment to keep up with war demands. One rolling giant is a truck-trailer being used to carry sub-assemblies of Consolidated



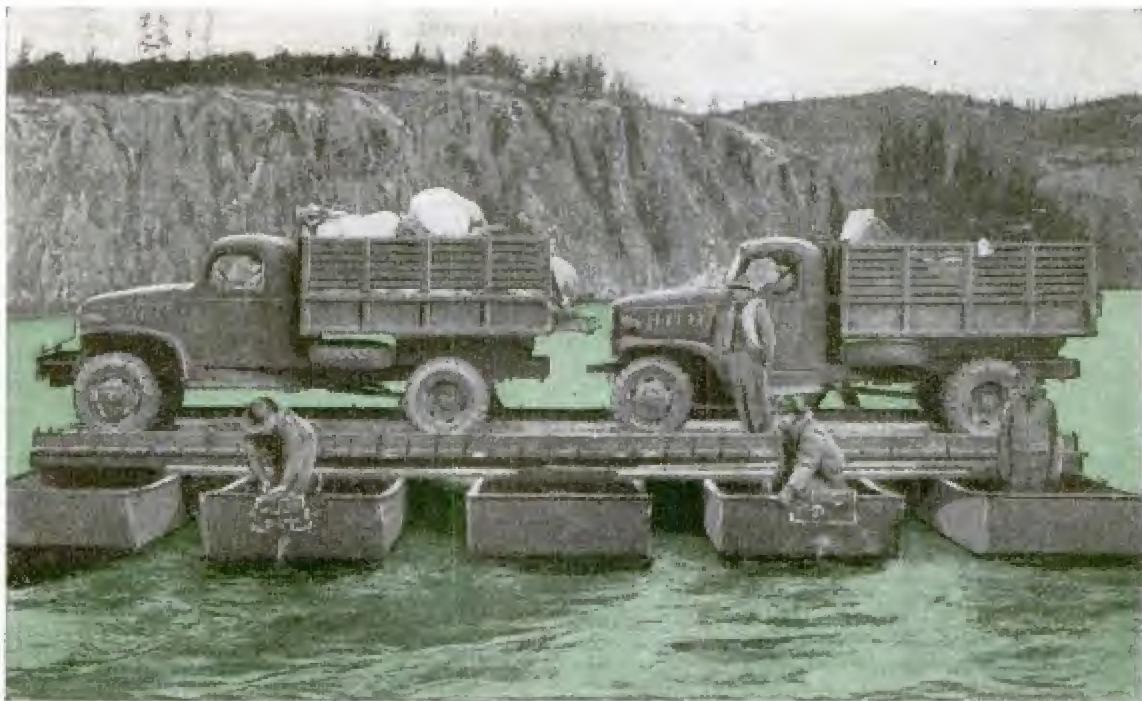
Flight deck jeeps moving planes for takeoff aboard a U. S. aircraft carrier. Below, military cargo carrier being tested on Studebaker proving ground

B-24 bombers from the Ford Willow Run plant in Michigan to final assembly plants more than a thousand miles away.

These huge trailers, probably the longest in service, are more than 64 feet long, nearly 8 feet deep inside and 10 feet wide. Two of them can carry an entire four-engine bomber, including everything except the propellers.

Trucking has played a vital part in removing many of the non-war federal agencies from over-crowded Washington, including the historic Patent Office. For two weeks, Allied Van Lines and two





Cargo-carrying trucks following the famous Alaska Highway are ferried across an Alaskan river

of its member carriers were hauling a total of almost 2,000,000 pounds of papers and equipment to Richmond, Va. It was regarded as the largest office moving job in history.

The Navy, too, is served by America's millions of trucks. In these days when life rafts are among the most important items aboard ship, trucks have been able to perform valuable service in delivering them to port cities. The Transco System of Denver, Inc., was called upon to deliver a cargo of life rafts from a plant in New England to the Pacific coast some 36 hours ahead of schedule.

The drivers of the trucks, fully conscious of the importance of their mission, passed up many a meal, cup of coffee and inspection as they roared across the country. In a climax as spectacular as any that could be devised in Hollywood, with a raging storm that extended from Chicago to the Rocky Mountains and a bridge washout that required a 200-mile detour, the rafts were hoisted aboard the transports a day and a half ahead of schedule.

Army statistics show that out of every 1,000 men inducted, 106 are

Phone booths mounted in trailer are boon to war plant workers

skilled in truck or tractor operation and 38 others were chauffeurs, mechanics, or servicemen in civilian life. This "savvy" of things mechanical—plus the herculean production capacity of Detroit—gives Uncle Sam a potent military factor.

In two years of war, 25 of America's peacetime automotive factories have become the greatest producers of destruction the world has ever known. Trucks and automotive tanks are serving in 70 theaters of war—blasting the Jap and Nazi, carrying men to the front lines, and getting supplies where they are most needed.

The extent to which the Army is relying on motorization is illustrated by the fact that the 400,000 horsepower of today's in-





Mobile ordnance repair unit is equipped to service any gun from pistol to howitzer. It is one of many trucks specially designed for war use

fantry division is 125 times larger than the 3,200 horsepower of the infantry division of World War I.

The fact that today's battles can be fought anywhere at anytime has given the motor truck a new importance. But they've got to be built rough and tough. Army trucks in Russia must operate in sub-zero cold; in India, Africa and Australia, the dust sometimes gets so thick that drivers must wear respirators to keep the stuff out of their lungs; in New Guinea there are torrential rains and axle-hugging mud to cause trouble.

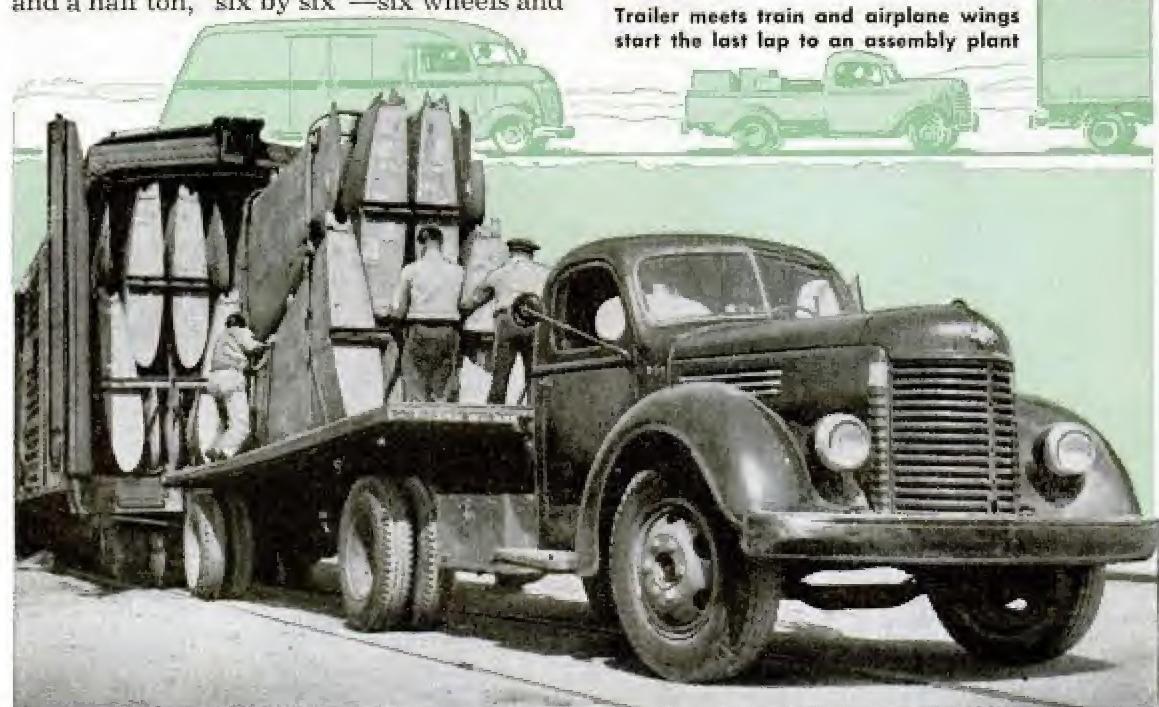
Out of the demand for an all-purpose truck, the Army developed the basic two and a half ton, "six by six"—six wheels and

all of them driving. It is used as a troop carrier, cargo carrier, a prime mover for the 75 mm. gun and the 105 mm. howitzer. Fourteen men can ride in the body of a "six by six." Other trucks range in size from the half-ton jeep to 12-ton monsters.

The record of American-built motorized equipment on the battlefield is bearing out the automotive industry's peacetime reputation for quality. In the North African campaign, for example, one motorized unit consisting of 166 vehicles, went through 32 days of continuous combat with only 12 minor mechanical failures, even though the vehicles had been driven nearly 500 miles across Egypt before the battle lines were reached.

Trucks are usually shipped overseas in a "knocked down" state to conserve shipping space. From the docks they are rushed to motor assembly dumps. Competition between the crews who assemble the parts is keen—with every crew trying to set new records. The average time required by a five-man crew to uncrate the parts of a two and a half ton cargo truck and roll it off the assembly line is five hours.

Trucks are performing hundreds of important tasks with the Infantry, Quartermaster Corps, Air Service, Signal Corps, Corps of Engineers, Coast Guard and the

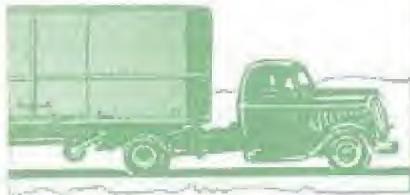


Marines. Many of these arms of the service are equipped with special trucks designed for unusual tasks. In the Southwest Pacific the Army has a truck-mounted water purification unit. It goes anywhere that wheels can roll and transforms the most polluted stream into a source of safe drinking water.

One of the most important pieces of equipment mounted on a truck chassis is the two stage air compressor, widely used by the Corps of Engineers. This truck provides flexible power for drilling, sawing, chipping and similar operations. It also plays an important part in demolition work, and is used for inflating the floats for pneumatic pontoon bridges.

Then, there is the lowly dump truck for all types of work. This is used in many units of the Corps of Engineers—a vehicle that is seen in the Army of no other country. This truck can easily carry the 13 men of a squad and their equipment.

Another less familiar but highly utilitarian truck built for the Ordnance Department is equipped with a small-arms repair body. With



this unit, gun repair crews can proceed at a high speed right onto the field of battle. Other completely equipped machine shops on wheels repair tanks and half-tracks wherever they happen to be knocked out.

Among the latest developments in mobile units are a complete lubricating truck, a tire repair shop and a water trailer. The lubricating truck, or "service station on wheels," can service two vehicles at once. It has a gasoline-engine-powered air compressor to operate greas-

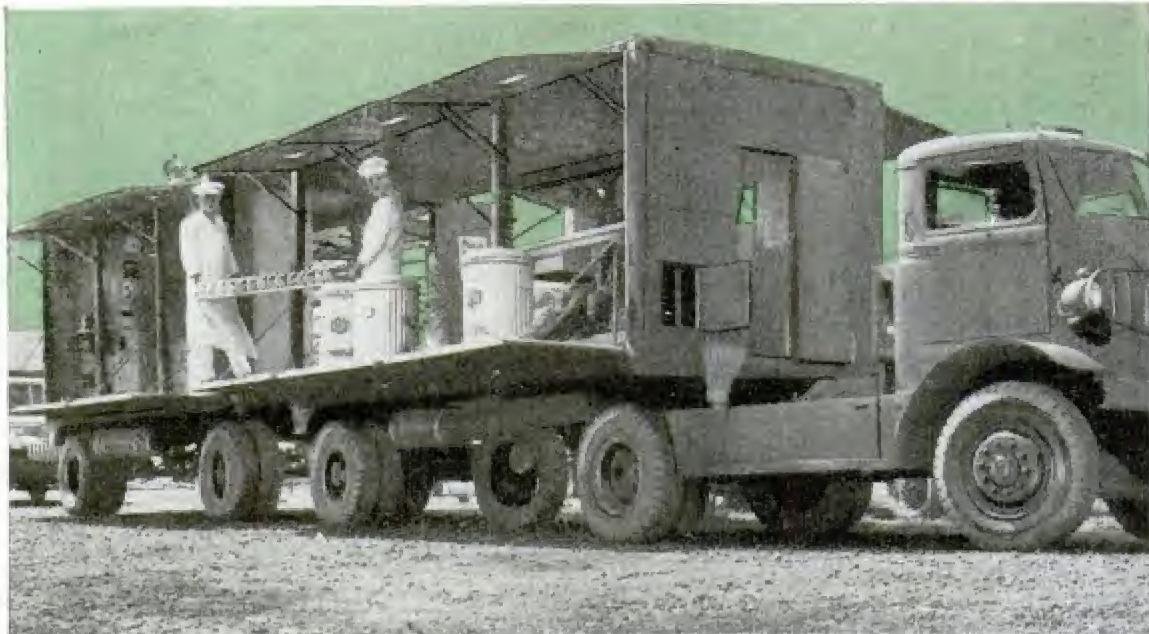


Even oil storage tanks sometimes are carried by trucks for hundreds of miles. Below, special equipment for digging telephone postholes fast



A jeep "goes ashore" from a 2½-ton truck "somewhere in New Guinea"





Bread fresh from the oven is ready for front-line soldiers at army's mobile field bakery

ing equipment, put air in tires and do similar tasks. It carries 100-pound drums that contain oil and grease.

The tire repair shop is designed to handle blowouts and tire repairs on the move. Punctures are patched and impact breaks repaired while the convoy continues on its way. The water trailer is fitted with two large spigots for quick radiator filling. Four small spigots are used for filling the canteens of thirsty drivers.

To replace shovels and sweat, there is a "six by six" fitted with an unusual looking machine for the rapid drilling of ground holes and for land-mine laying, tank-trap construction, or any operation where holes must be bored in the earth.

Another truck equipped with a special body is used by the Signal Corps, and contains both sending and receiving radio apparatus.

The Army must be fed, and today's soldier uses trucks not only to transport food but as mobile bakeries and kitchens. Mobile laundry units have been procured by the Quartermaster Corps, as well as sterilization bath units for overseas use. Army clothes are now washed and deloused by special paraphernalia in these special mobile laundries. They are mounted on semi-trailers, and 16 of them can serve approximately 48,000 men per week.

When, in earlier wars, a soldier broke or misplaced his glasses, there was nothing

This giant wrecker can hoist 10 tons or eight vehicles like the tiny jeep it dwarfs in passing



for him to do but to continue on with impaired vision. Thanks to motorization, circumstances are different in today's war. Mobile optical shops have been designed, equipped and mounted on a truck chassis. A typical optical shop contains special optical machinery, 36,000 lenses, 8,400 frames, 600 pairs of extra temples, and 1,200 spectacle cases.

Trucks fill a vital need of antiaircraft units of the Coast Artillery with a two and a half ton, six-wheel vehicle for transporting giant searchlights. This unit has a five-man cab, in order to carry the entire searchlight crew. In addition, such trucks travel in pairs, one carrying the searchlight, and the other the electrical generating equipment and listening devices.

Army trucks haul oil for smoke screen "smudge pots"—particularly in the Panama Canal Zone and where other vital fortifications are located. Some are equipped with cranes for delivering bombs to airplanes. Others are used for fire protection at air fields and Army posts.

A sling full of supplies for our fighting men is hoisted into a waiting truck

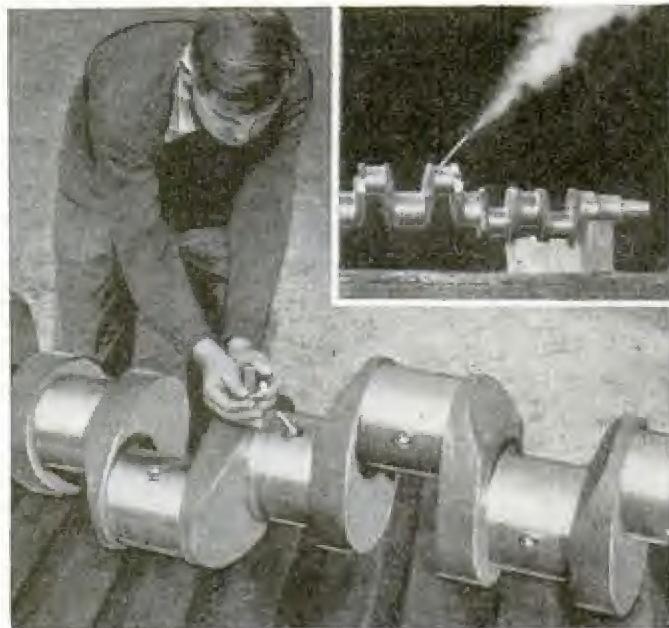


Some trucks house map reproduction laboratories and photographic development dark rooms, while others serve as mobile tailor and cobble shops. Right here at home you will even find mobile recruiting stations mounted on truck chassis.

A completely mechanized battalion laying mines on roads to stop enemy tanks and scout cars



Dynamite Blasts Broken Drill From Crankshaft



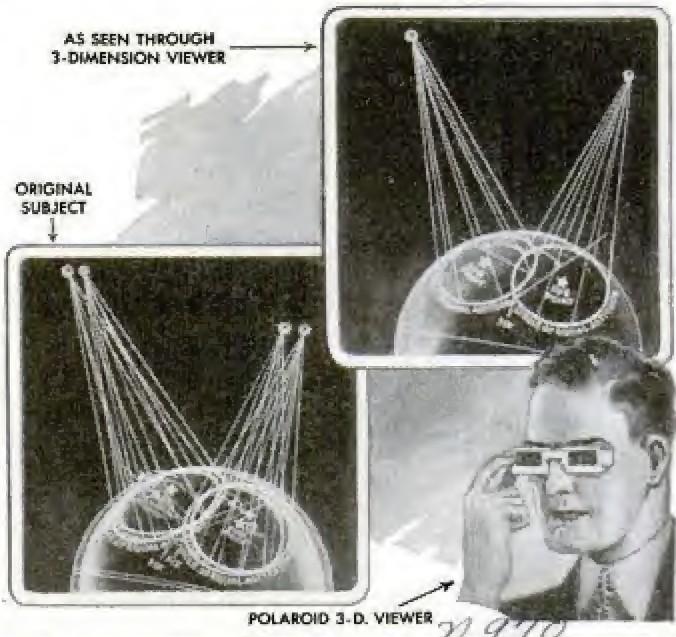
Broken drills or other obstructions are removed from oil holes in steel crankshafts with a small charge of dynamite, usually less than a thimbleful. The dynamite, which must be handled carefully, is set off with a fuse, and has no more effect upon the metal than a fired cartridge upon a rifle barrel. After the fuse is ignited, a heavy plank or metal shield is placed over the charge. Broken drill bits of large size often require several charges. In one month, the Ohio Crankshaft Company in Cleveland salvaged 93 crankshafts with this dynamite technique developed by an employee.

**
Lighting fuse attached to small charge of dynamite in oil hole to blast drill from the shaft*

11963 Cadet's Polarizing Goggles Give "Depth" to Picture

Military navigation students are trained to "see and think three-dimensionally" with a viewing device similar to the stereoscope. Two pictures of the heavens and earth are superimposed on a plastic sheet, and when viewed through polarizing goggles present a single picture in three dimensions. The picture is called a vectograph. It can be thrown on a screen by a projector and studied by a group of students. The vectograph was developed by Prof. John T. Rule of Massachusetts Institute of Technology.

Student navigators get a three-dimensional view by viewing the "blurred" picture with goggles

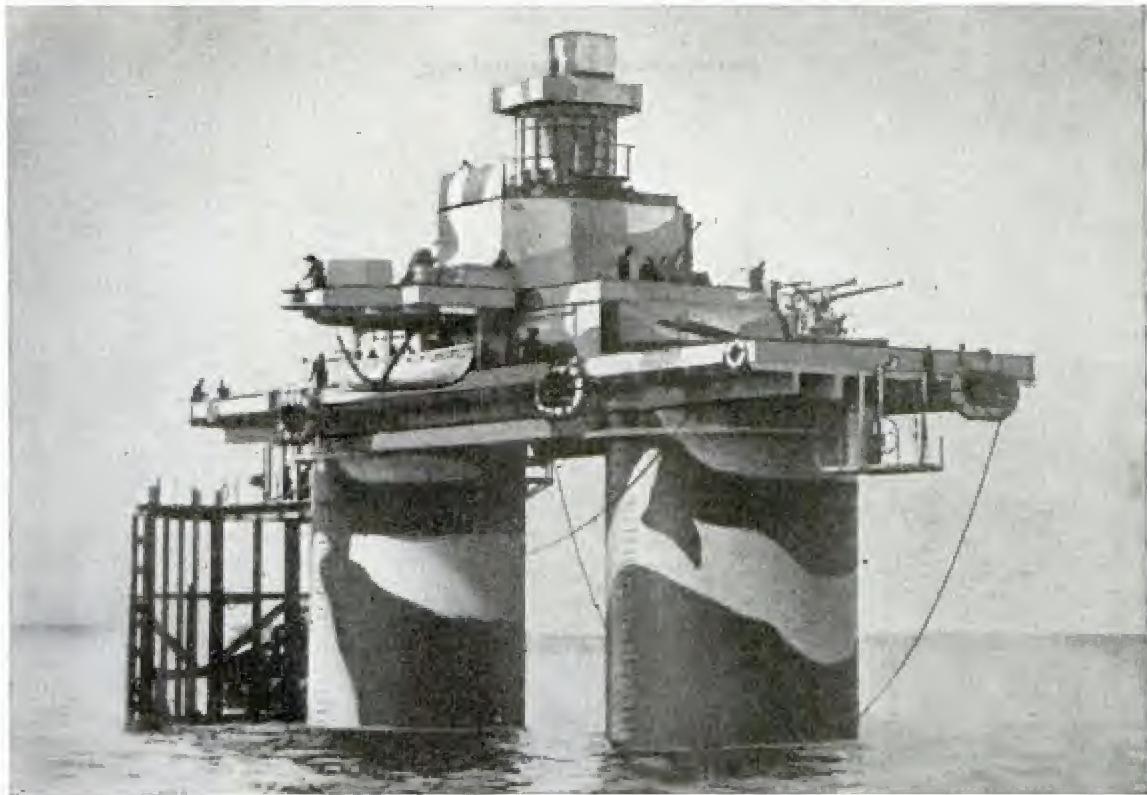


"Self-Starting" Airplane Tires Have Fins in Sidewalls to Catch Air



Smoother landings and a reduction in landing-shock wear are predicted with a "self-starting" airplane tire that attains a high rolling speed before it touches the ground. Fins built into the sidewalls of the tire catch the air and set the wheel spinning. The fins, made of rubber and fabric, flatten out for the "upper half" of each rotation of the wheel. This eliminates the air-drag effect of rigid fins or vanes.

British "Island Forts" Blast Low-Flying Aircraft



Britain built these formidable outposts along England's east coast to guard ships against Nazi planes

"Island Forts" are protecting Britain's east coast shipping from low-flying aircraft. Rearing out of the water like stationary sea monsters, they bristle with guns and armor and have shot down a

number of German planes. The fortresses are commissioned as ships, being named after the sands on which they stand. All armament is manned by Royal Marines, and officers have naval ratings.

11878

Soldiers on "Icebox" Treadmill Test Effects of Battle Cold



Soldiers exercising in subzero chamber. They breathe into recording device which shows effect of Arctic cold on troops

To determine just how efficient a soldier is in combat under sub-zero conditions, the Armored Medical Research Laboratory at Fort Knox puts soldiers on a treadmill, marching endlessly in temperatures down to 40 below, with an occasional 60-mile gale for variety. The tests proceed in a special cold room, whose temperature and other climatic conditions are carefully controlled. Clad in parkas and pile-lined garments, the men breathe into a recording device, their respirations revealing the state of their metabolism, and revealing to physiologists their every reaction.

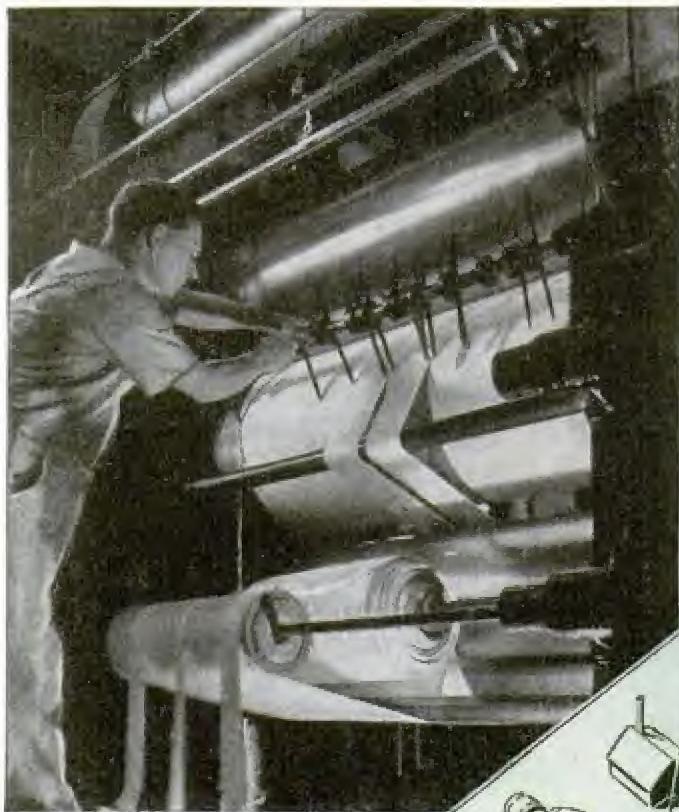
Paper clothesline, which is water repellent and supports a load of 250 pounds, can be left up permanently outdoors.

6. W. Mitchell Co., Inc.
2800 N. 3rd
Phila., Pa.

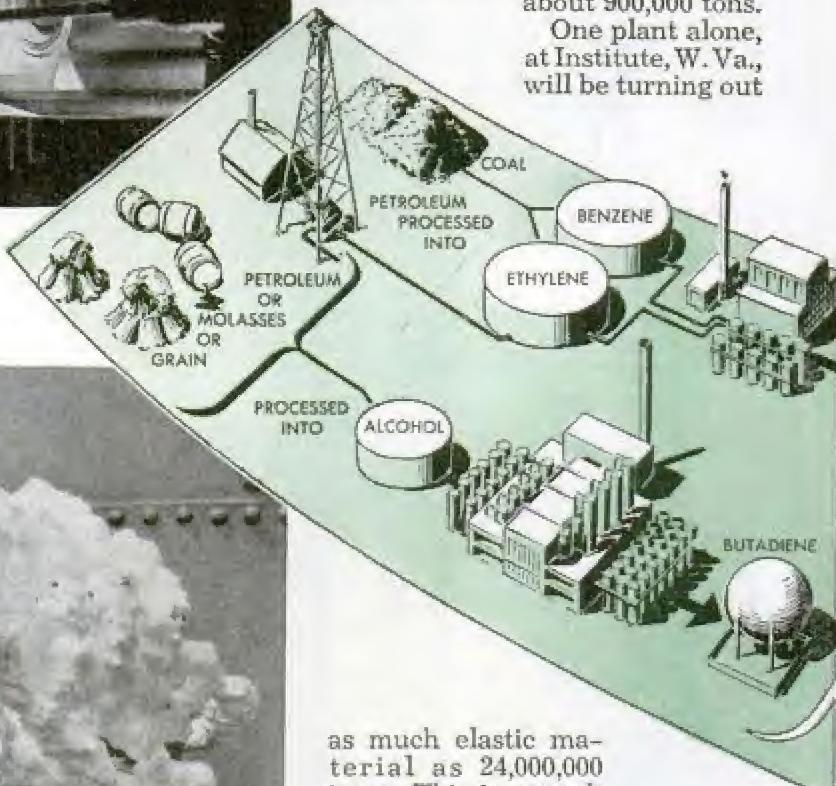
Mr. Allen Marlowe & Miss
Park Ave.
N.Y.C., N.Y.

7/1928

BOUNCING BABY with a



Cutting rubber strips for tires in a Firestone synthetic plant. Below, an armful of synthetic rubber made from petroleum gas Standard Oil Co. of N. J.



as much elastic material as 24,000,000 trees. This is enough rubber to manufacture 63,000 passenger car tires per day.

While this huge output consists almost entirely of four types of synthetic rubber, the bulk made from alcohol or petroleum, it is estimated that more than 4,000 other rubber substitutes have been developed. Homes, farms, factories—even your postwar

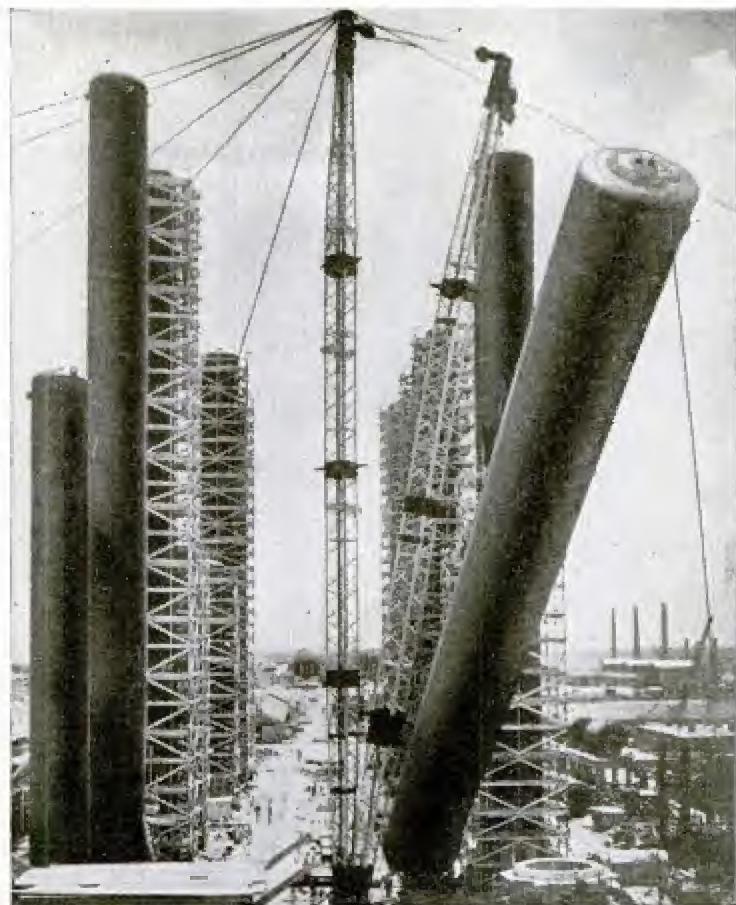
FUTURE

clothing, furniture and autos will be changed by these elastic plastics.

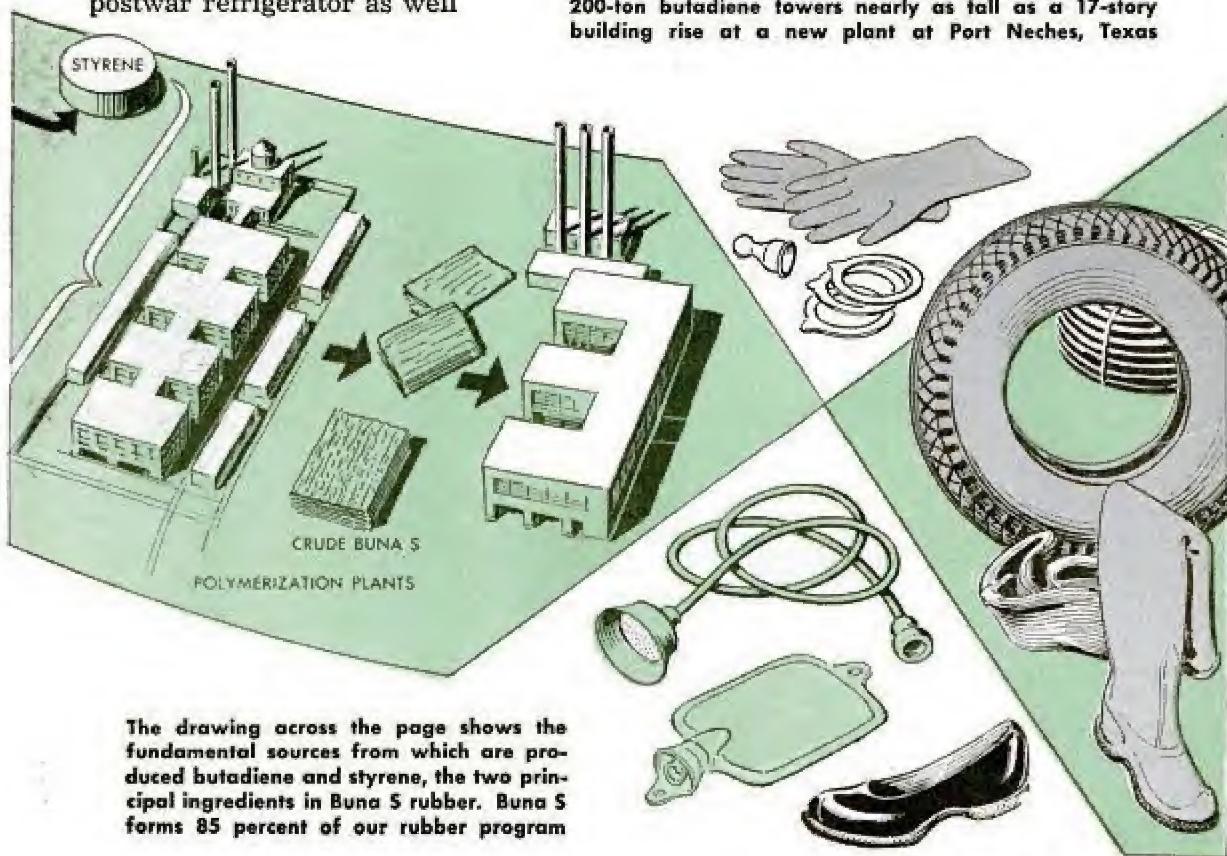
Take your postwar automobile. Even if low-cost natural rubber returns, synthetics will add to tire mileage. Dipping the finished tire in synthetic rubber provides a coating which protects the tire from the rotting effects of sun, grease and oil.

There will be no necessity of checking the air in your tires every time you buy gas. A synthetic rubber made of coal, limestone, salt and water is now being formed into a leakproof inner tube, a function natural rubber has never been able to fill.

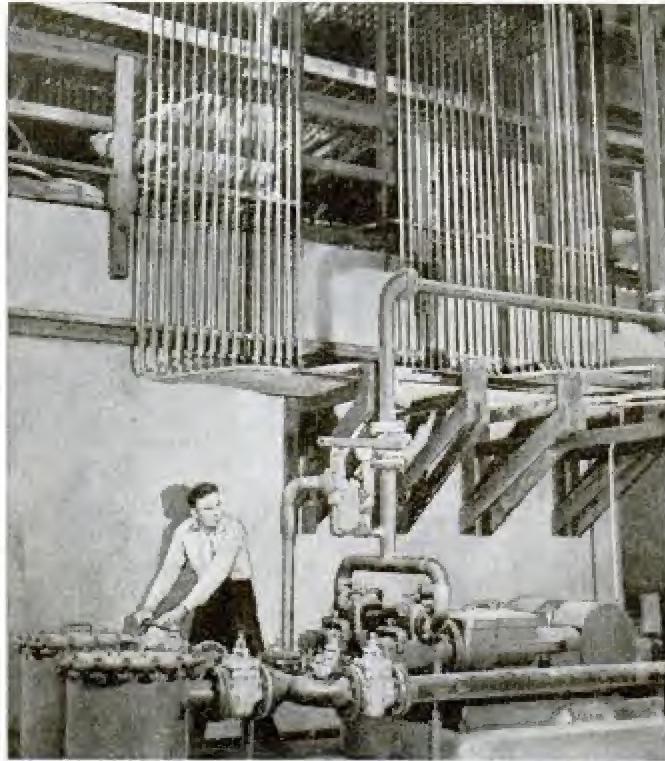
Travel fatigue from continued vibration and rumble, can be eliminated by synthetic cellular rubber. This material, used as a lining for car bodies, will silence the car and add such excellent insulating qualities that it will probably improve your postwar refrigerator as well



200-ton butadiene towers nearly as tall as a 17-story building rise at a new plant at Port Neches, Texas



The drawing across the page shows the fundamental sources from which are produced butadiene and styrene, the two principal ingredients in Buna S rubber. Buna S forms 85 percent of our rubber program



Synthetic rubber latex blending tanks at Institute, W. Va.

as modify the temperature of your auto. Tested as lining in army tanks it was found also to be nearly flameproof.

Rubber cushions may eliminate seat springs and manmade rubbers have been found to excel natural rubber for windshield wipers, fan belts, ignition cables, wire insulation, gaskets.

Flaming death for motorists when a crack-up explodes gasoline should be less of a menace in the postwar car because of the development of self-sealing aircraft gasoline tanks. These tanks use two types of synthetic—an inner layer which does not deteriorate in the presence of gasoline and another layer which swells in the presence of gasoline. This sealing takes place so rapidly that a bullet hole is sealed much as clotting stops the loss of blood before more than a teaspoonful of gasoline has been lost.

The roof of your post-war home may be made of a new compound resisting ice, rain, sun, heat

The Institute plant is operated for the government by U. S. Rubber Co. This tower cools 20,000 gallons of water per minute

30 Institute, W.
Va.

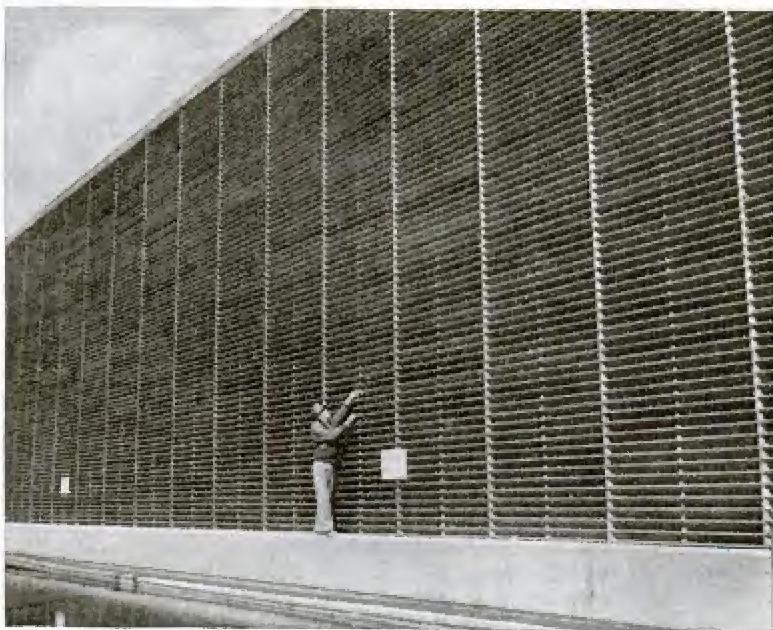
and cold. You may have floors composed of an attractive and durable synthetic rubber now applied to decks of warships which enables a sailor to retain his footing even when the rubberlike material is wet and tilted to a 45-degree angle.

Impregnation of fabrics with synthetic rubber compounds is likely to mean easier cleaned and more lasting draperies and upholstery. Kitchen drainboards, hot water bottles, and hundreds of other household articles have proved superior when made with synthetic rubber. It may be molded into chairs and smaller articles of furniture.

Synthetic rubber shoe soles are superior to leather for such workers as railroad track walkers. Fishing togs, which are both light and weatherproof are only waiting peace for production. Elastic thread which resists laundering and perspiration is ready for production and what may be expected in the line of rubbers and boots is

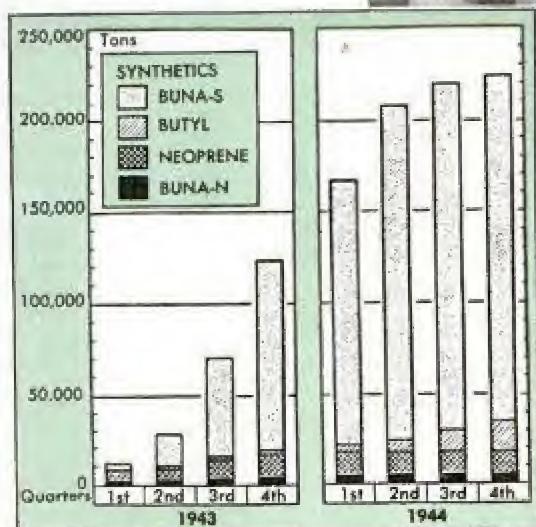
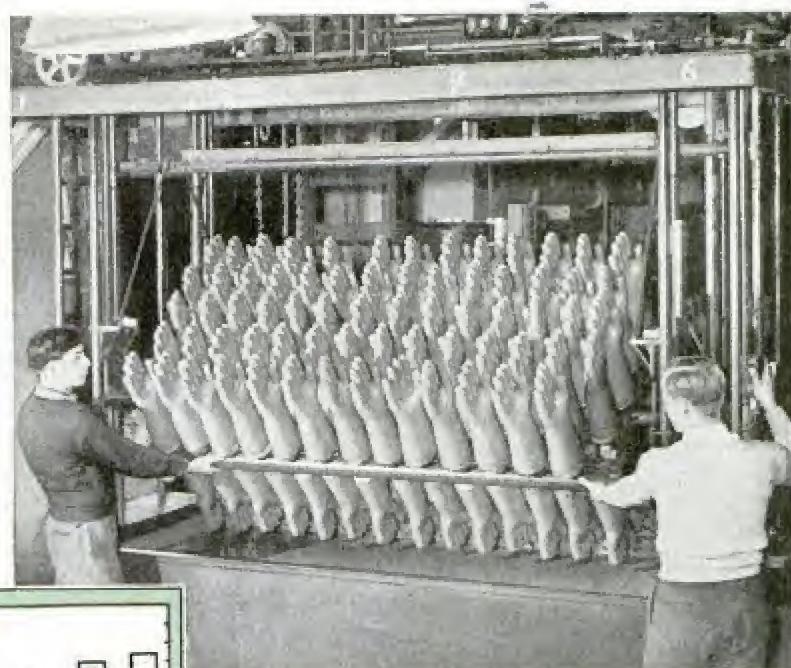
indicated by the fact that synthetic rubber jungle boots have replaced leather in the steaming swamps not only because they resist water and heat, but because they will not mold, mildew or rot.

Special synthetic rubbers are being put to such varied uses as printing plates, sponges, fire hoses, TNT buckets, conveyor belts, insulation tape, caulking compounds and adhesives. A moistureproof film is playing a vital role in the treatment of infantile paralysis. One of the steps in the



famous Sister Kenny treatment, is the wrapping of a patient at frequent intervals in blankets soaked with extremely hot water. This helps to keep the muscles limber and prevents further atrophy. After the blankets are applied to a patient, in many hospitals, a wrapping of plio-film is added. Its low conductivity helps to retain heat and moisture.

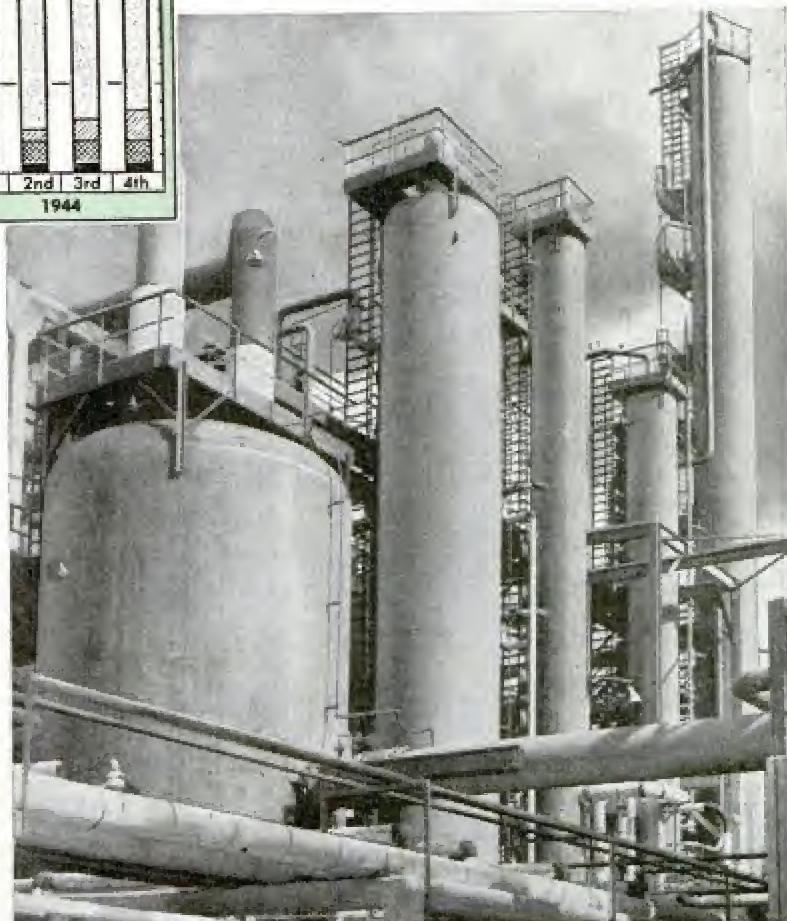
On the war front, synthetic rubbers are serving in life rafts, life preservers, salvage balloons used to raise sunken



Dipped in Neoprene, these synthetic rubber gloves for the army are impervious to deadly mustard gas

Chart at left shows estimate of our synthetic output

In these towers and reactors at Standard Oil's Baton Rouge refinery, petroleum gas for rubber is processed



airplanes, propellers, flameproof hoses, fuel tanks, firefighting suits and buoyant wading garments. A Flying Fortress uses 1,250 pounds of rubber, a medium tank 1,750 pounds and a battleship 150,000 pounds.

Fortunately there has been no shortage in synthetic rubbers for our armed forces, although the scarcity of civilian tires often leads to this belief. In fact, we have produced so much rubber in so short a time that there have been periods with a surplus. The reason this surplus has not gone into civilian tires is that tire plants have been dismantled or scrapped,



U. S. Department of Agriculture photo

Heat is No. 1 enemy of household rubber. Don't use the stove for a drier! Stuffing galoshes preserves shape

experienced rubber workers have gone into other industries and too few men are available who know how to make tires of synthetic rubber, a more complicated task than standard tire making.

The principal synthetic rubbers in the government program are Buna S, Butyl, Neoprene and Buna N. The first two can be made from petroleum. Buna S is the only rubber to be used in quantity for tires. Buna S plants supply about 85 percent of

the total synthetic rubber manufactured. It is made by combining styrene and butadiene in a latex-like emulsion which is then processed much like natural latex. The process is called polymerization, which means stringing together of similar molecules to form long molecular chains. Raw materials for styrene may be obtained from coal. Butadiene may be made from petroleum, from alcohol, or by special fermentation processes.

Butadiene is a gas at ordinary temperatures and pressures. It is liquefied by pressure or refrigeration for easier handling. It is manufactured both by extracting it directly from cracked gases, and by removing hydrogen atoms from butylene, a refinery gas.

In making Buna S, butadiene and styrene are polymerized in large reactors, resembling giant kettles. A soapy emulsion and a catalyst are placed with them in these reactors. These various products are heated to exact temperatures and under carefully controlled conditions the molecules "hook up" and form a milky latex similar in appearance to that obtained from the rubber tree.

Buna S is highly resistant to heat, abrasion and the aging action of sunlight and air. It can be vulcanized and worked by the same machines used for natural rubber.



Butadiene storage tanks at Institute, W. Va. Pressure is so high only spherical tanks can hold gaseous butadiene
OWI photo



"The CAISSENS

5872 June 1944
Der Fuehrer
77843

GO ROLLING ALONG!

THE battle had reached its critical stage and now the Germans were massing more infantry for a final powerful effort. There would be a smile on Der Fuehrer's face tonight if the Americans could be pushed back.

But the German drive never got started.

Without warning, their assembly area suddenly became an inferno of noise, concussion, and flying steel. When the terrific explosions ended there weren't enough men left to halt the advance of a baby buggy.

It was no new American super rocket nor yet "pin point" bombing by aircraft that had cut them down. The devastation was caused by Yankee field artillery.

Twelve big 155 millimeter field guns in less than one and a half minutes had poured tons of high explosive shells

A far cry from horse-drawn guns of World War I is this self-propelled 155 mm. giant, the M-12, mounted on chassis of medium tank. Hinged supports at rear dig into ground. Below, loading the M-12





Swabbing out the barrel of an M-12 getting ready for next round of firing. Gunners seldom see shells land

Captured Italian antiaircraft and antitank gun is shown in firing position; truck has a Diesel engine.

Signal Corps photo

into the area. Some of the shells were fused to burst on impact, others were timed to explode over the heads of the enemy, hurling metal in all directions.

Tanks, rockets, airplanes, and all the new weapons of war might make you suppose that artillery is out of date. The truth is that nothing has been found that can deliver so consistently the telling punch of a big shell. Field guns continue to be one of the most important weapons of the world's armies.

With massed artillery fire the Russians have turned German advances into routs. With shellfire, British and American forces have smashed German strongholds that resisted tanks and aircraft.

Artillery has come a long way since the days of the first world war. Then the howitzers and guns were horse-drawn; now they are



either self-propelled or are towed by wheel- or tractor-type prime movers. Obtaining the initial firing data used to be a slow and complicated process; now such adjustments are made by slide rule. Artillery fire was not always accurate in the past; today a gun crew can lay most of its shells inside a 35-yard radius four miles away.

The Germans are proud of their "88" which has been a potent weapon against Allied tanks and troops. The American answer to the "88" is the new 105 millimeter howitzer that packs the wallop of a medium field piece and yet is light enough to be served by only a few men, towed rapidly behind a truck, and moved quickly into advanced positions. The 105 has a split trail, a wide angle of fire, and uses a round that contains both shell and powder charge. It is possibly the most accurate gun of its type in the world.

Back of the 105 howitzers in a typical battle area lie the long range guns that can reach out over the scene of combat and pick off distant enemy targets. Among such cannon is the 155 millimeter howitzer whose short barrel can throw shells at high angles and drop them on hidden targets.

As mobile and of longer range than the howitzer is the new self-propelled M-12 155 millimeter gun. This weapon is mounted on the chassis of a medium tank and can make its way unassisted across rough ground to reach a good position. The armored rear wall of the gun compartment is hinged so that it swings down to form a spade that digs into the earth as a support. This gives the mobile cannon the firing stability of a fixed gun.

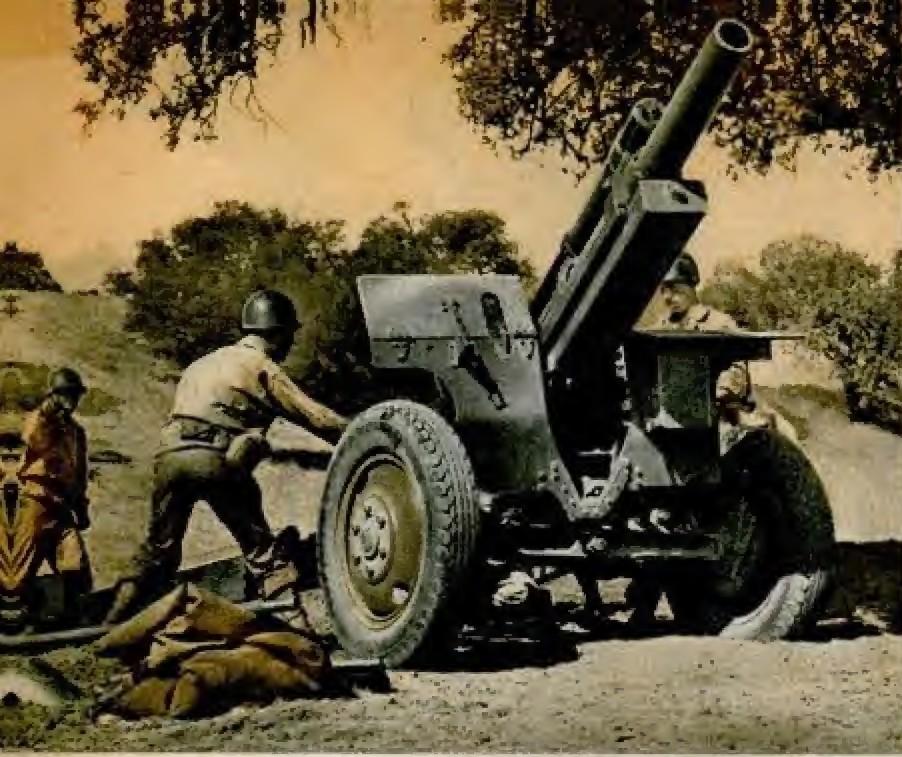
Aiming M-12 at distant target first plotted on the firing chart



Hidden under trees, this switchboard is nerve center of artillery unit

In the same category is the big 15-ton M-1 "Long Tom" gun of 155 millimeter size, with the longest barrel of all. It can reach out to targets 15 miles away. The Long Toms made a name for themselves, together with aircraft, in the re-taking of Kasserine Pass in North Africa, and they played an important part in Sicily and in





Preparing to fire 105 mm. howitzer—America's answer to Nazi's "88"

the northward advance through Italy. The M-1s are mounted on huge rubber tires for transport and are towed by tractor-type prime movers that also serve to carry the gun crews and ammunition.

There are four big guns in a battery. Three such batteries make up a field artillery battalion that has its own aerial and ground observers, radios, fire direction center, and telephone network. The entire organization is mobile, ready to pick up and leave or to dig in at a new location in a matter of minutes. The guns are moved into position under trees or are blended into their surroundings with camouflage. Each gunner digs himself a fox hole, and linemen hurriedly lay telephone wires for fire control and other communication.

There's no time for idle talk behind the

flies from the ground. Members of the gun crew are in a crouched position. Their mouths are open to equalize the pressure on their ear drums.

The other three guns of the battery fire in sequence and then, possibly 15 or 20 seconds later, you begin to hear the distant explosions of shells bursting on their targets. Meanwhile, the gun crews are swabbing out the powder chambers and preparing more rounds for firing. The gunners seldom see their shells land. The targets are usually out of sight and there's little time to watch, anyway.

No two shells from the same gun are likely to land in exactly the same spot. Variations in temperature, atmospheric pressure, and the winds aloft all require minute adjustments in the aim. In addition there is "probable error," a factor that disperses the shells over all parts of the target area. Even the force with which a shell is rammed into the breech may influence the range.

Aiming big artillery field pieces is usually done by map. Once a gun is oriented it can be brought to bear on any target within its range by a few turns of its traversing and elevating wheels.

"Enemy tanks and artil-

big guns during action. Commands are coming in too fast.

"Battery adjust!" the battery commander roars. "Shell H.E., charge super, fuse quick, base deflection one two zero, battery right, quadrant four one zero!"

That jargon told the gun crews what type of shell to load, the amount of powder that is to go in behind the shell, the type of fuse to be placed in the shell, the aiming direction, the order in which the guns are to be fired, and the elevation of the barrel.

"Fire!"

The number one cannoneer of the right hand gun pulls his lanyard. The gun roars, the barrel slams back in recoil, and dust



M-12 takes short cut over open country on way to front lines

lery are moving along a road 400 yards beyond Check Point 28," may be the report phoned in to the fire direction center by a distant observer. Immediately, plotters figure this location on their firing charts and then take off the ranges and deflections that are to be telephoned to the executive officers at the guns. Sometimes one preliminary round is fired by one gun so the aim of the others may be corrected, if necessary, after the observers spot the shell burst.

Right, commander using aiming circle instrument signals to gun crew. Below "AA" gun mounted on truck



If it is planned to catch the target by surprise, such a sighting round may be aimed at a point that is a known distance from the target. The relation of this shell burst to its target allows the plotters to estimate the aim to be used by all the guns for hitting their real target.

Quite possibly, too, this preliminary round will be fired by a gun that has been moved

Continued to page 152

Three Yanks inspecting a captured German "super" 75 mm. antitank gun
Signal Corps photo



Alaska Relays
U. S. Coast Guard
Washington, D.C.

0003

Trucks Guard Flying Boat From Arctic Squall



An Arctic squall in Alaska gave Navy trucks a new job—acting as anchors and windbreakers for a Catalina

Navy trucks—a whole fleet of them—prevented the wrecking of a U. S. Coast Guard PBY flying boat at an Alaskan base. A sudden Arctic squall, known as a willi-

waw, threatened the PBY with destruction. The trucks were driven onto the landing strip around the plane and served as both windbreak and anchor.

0975

Giant Tong Lifts 80 Tons in Claws With 69-Inch Spread



The tong is so massive it can easily pick up ingots weighing 80 tons

Ingots weighing tons are lifted like feathers with a massive tong that has a lifting capacity of 80 tons. The big tong, used in a major steel plant, has an opening of 69 inches and weighs 12,489 pounds. It is suspended from an overhead crane, and operates automatically.

034

Air Engine Adapted For Tank Drive by Minor Changes

Wright Whirlwind airplane engines are almost identical with the Wright engines used to power the General Grant and General Sherman tanks and the M-7 self-propelled 105-mm. howitzer. The engine was adapted for use in tanks by the addition of a combination cooling fan and flywheel mounted on the propeller shaft in place of the propeller and by changes in the induction system.

Fonda Corp. O 14
309 G 2nd St.
N.Y., N.Y.

Sound on Cellophane Tape Played Like Record

About the size of a portable radio, a sound-recording machine makes records on Cellophane tape. It can be plugged into a radio or microphone for recording, and the flip of a switch plays the record back. The Cellophane used is twice the thickness of cigarette wrappings and about an inch wide. Three hundred and fifty feet of tape provides eight hours of recording. The inventor got his idea from movie sound track.

Dave Jay Fonda

Sound-recording Cellophane tape is being developed for home use. The sound is recorded and re-played in a machine plugged into the radio



Robot Arm Swings Bottle To Christen Ship N 943

"Christine" has christened more than a dozen new army tugs in the last six months. "She" swings a mechanical arm to whack the new vessel with a bottle of champagne as it goes down the ways, putting even the christening on a production line basis. The device is attached to the bow of the ship by tack welding, and consists of a pivoted arm held out horizontally from the bow by a spring catch. This catch is released by a trigger attached by a line to a stationary object. As the vessel slides into the water, the slack in the string is taken up and the bottle fixed to the end of the arm swings against the bow.

*Consolidated Shipbuilding Corp.
Morris Heights, N.Y., N.Y.*

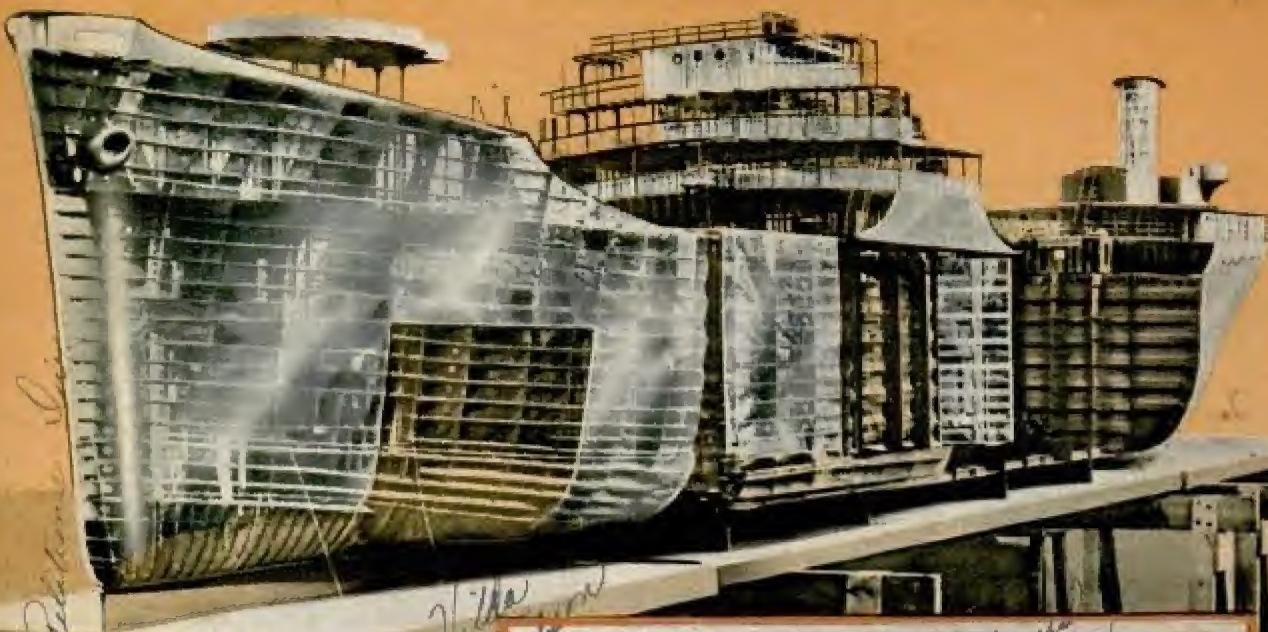
Small Signaling Mirror for Lifeboats "Hits" a Target 10 Miles Away

Resembling a small mirror with a cross-shaped aperture in the center, a signaling device takes the guesswork out of "hitting" a target 10 miles away. It consists of a plate of heat-treated glass coated on the back with a transparent protective lacquer. On the center of the back side is a mirror about the size of a silver dollar, and in the center of this "aiming" mirror is the aperture. A cross-shaped spot of light from the aperture is caught on the upraised hand of the user as he "aims" at the

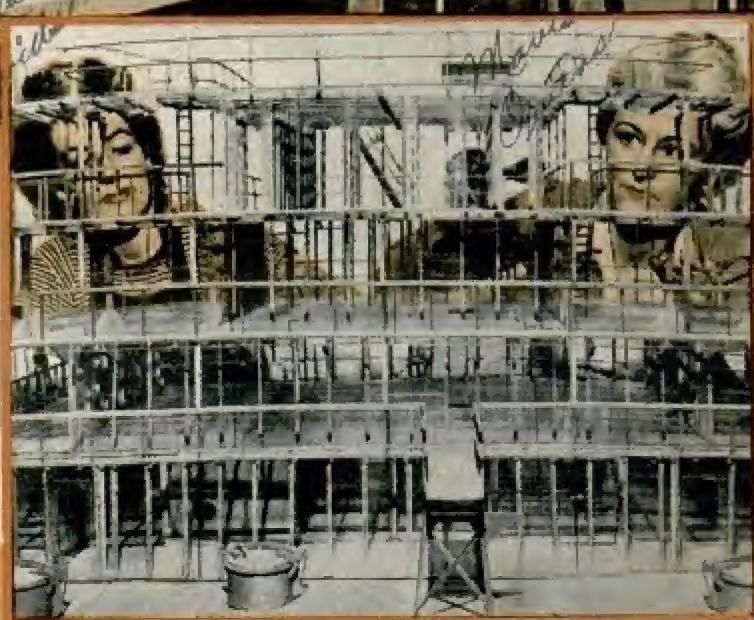
target, tilting the mirror to superimpose the cross-shaped image in the rear mirror upon the aperture while he sights through this opening at the target. The device is used on rafts and lifeboats, and by airplane pilots stranded in isolated country.



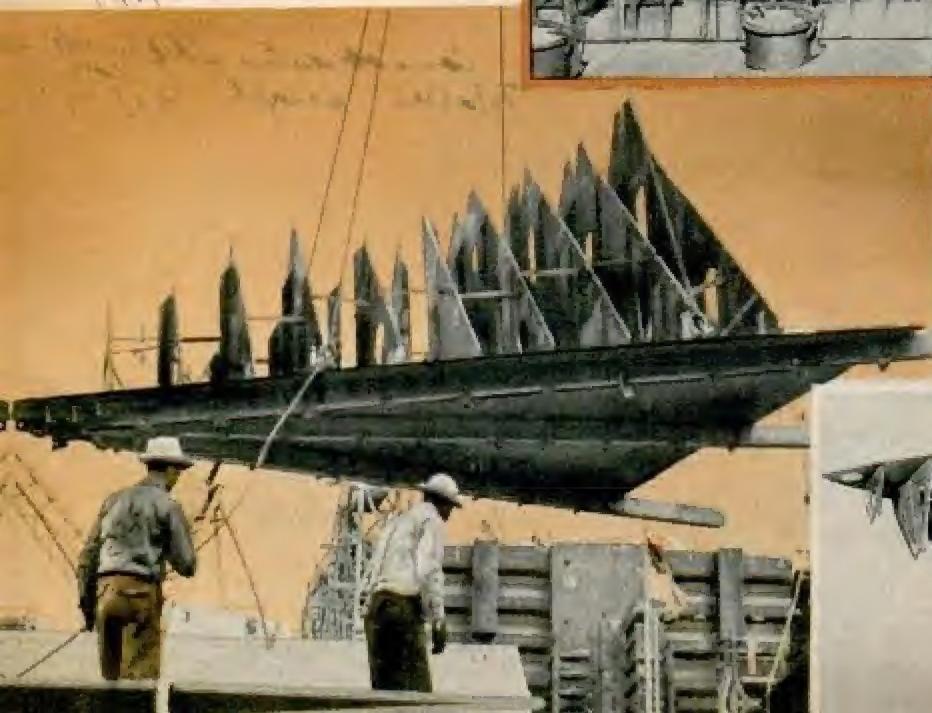
MODEL TANKER trains SHIPBUILDERS



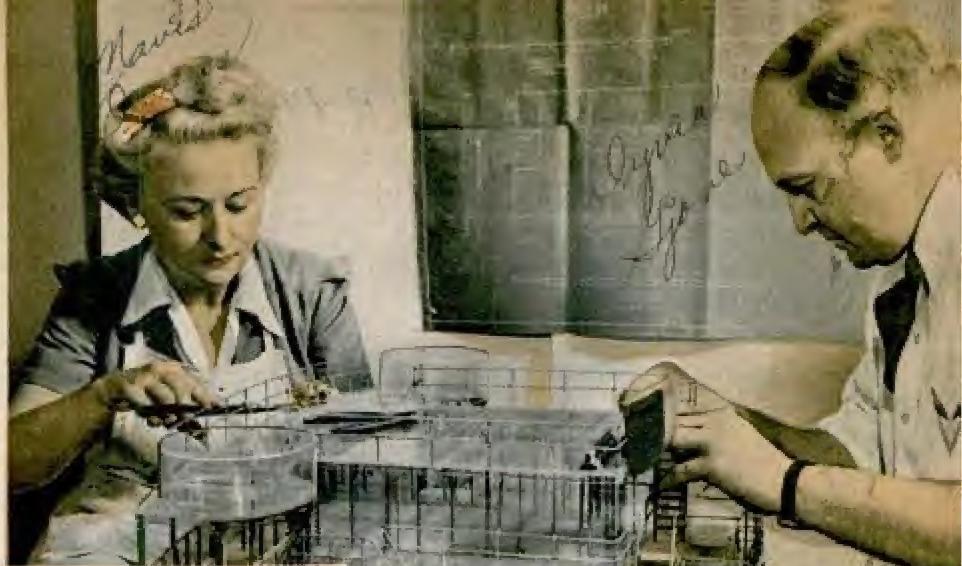
The Marinship Corp., Sausalito, Calif., has a "shipyard" within a shipyard—the Marinship Model Shop, where miniatures of the company's products are made to simplify the training of new workers. Above, a 20-foot model of a 16,500-ton tanker, made in sections can be used separately or combined. Right, women at work on an intricate midship deck house assembly. Employees of the ship builders learn how to do their jobs by studying each part in miniature.



Left, the 8½-ton steering gear flat is lifted from pre-hull assembly skids by a single crane before installation on ship rising on ways in the background. Below, a copy of the same flat has been fabricated in inverted position and "flopped" into the proper position to be put on a hull, just as is done in yard.



Craftsmen supply the ticklish detail work necessary for the midship deck house assembly. This intricate job is so tremendous that only one complete model of the entire ship has been made. The models often are used for experiments in planning how to put large sections of the ship together. Edward A. Owens, formerly of the U. S. Engineers Corps, is head of the shop. Most of his assistants have had either art or drafting school experience



Left, a view of the midship deck house as it is in the shipyard. The scale for the models is a half inch to one foot. In the shop draftsmen lay out and cut templates, or patterns, from the ship's blueprints and construct the miniatures out of acetate and fiberboard. Then they make scale duplicates of the prefabricated sections produced in the shipyard



Two gantry cranes are needed to lift the 65-ton lower stern section, carry it the length of the shipways, and lower it into position aft. Below, model of lower stern has a hole for shaft tunnel which eventually will carry tail shaft. Note stern frame ready for rudder



7974

Jungle 'Phone Without Batteries Has Five to 10 Mile Range



Operated without cumbersome batteries, a sound-powered telephone adopted by the U. S. Army Signal Corps is used in jungle combat areas. It has a normal range of five miles, and under favorable conditions can carry messages up to 10 miles. There is no current flowing through the circuit as in an ordinary telephone. Instead of the usual microphone, the instrument has a diaphragm which is attached to a coil. The coil is set up within an electro-magnetic field and as it vibrates the field is cut, inducing a current.

757

Blood Donor Gets Cells Back After Separation of Plasma

Restoring the red cells to the blood donor, rather than discarding them, as is done now, would make 800 percent more plasma available to the armed forces, according to a recent article in the Journal of the American Medical Association. The interval between blood donations now considered safe for the donor is based on the rate of regeneration of hemoglobin, red coloring matter and oxygen carrier of the blood. The total protein lost by each donor with

each pint of blood donated is slightly over three ounces. If the red cells are reinfused into his veins, he is spared 80 percent of this drain and theoretically should be able to donate plasma five times more frequently than the present practice of every eight weeks. Shortening of the interval between donations to one week, which might cause an unfavorable change in disease-resisting factors in the donor's blood, is not advised, however, until further studies are made.

Portable Self-Powered Heater Operates by Forced Air

Postwar domestic heating may be revolutionized by a portable, automatic forced warm air furnace developed by the Army Air Forces. The furnace, which weighs only 45 pounds and is about as large as an average traveling bag, is equipped with its own fuel supply and a tiny, precision-built prime mover. It is expected the heater's flow of pure heated air would keep an average single family home warm in the coldest weather, since tests show the unit will operate successfully in temperatures 70 degrees below zero. The Norge Division of the Borg-Warner corporation, Detroit, Mich., cooperated with the Air Forces in the development of the furnace.

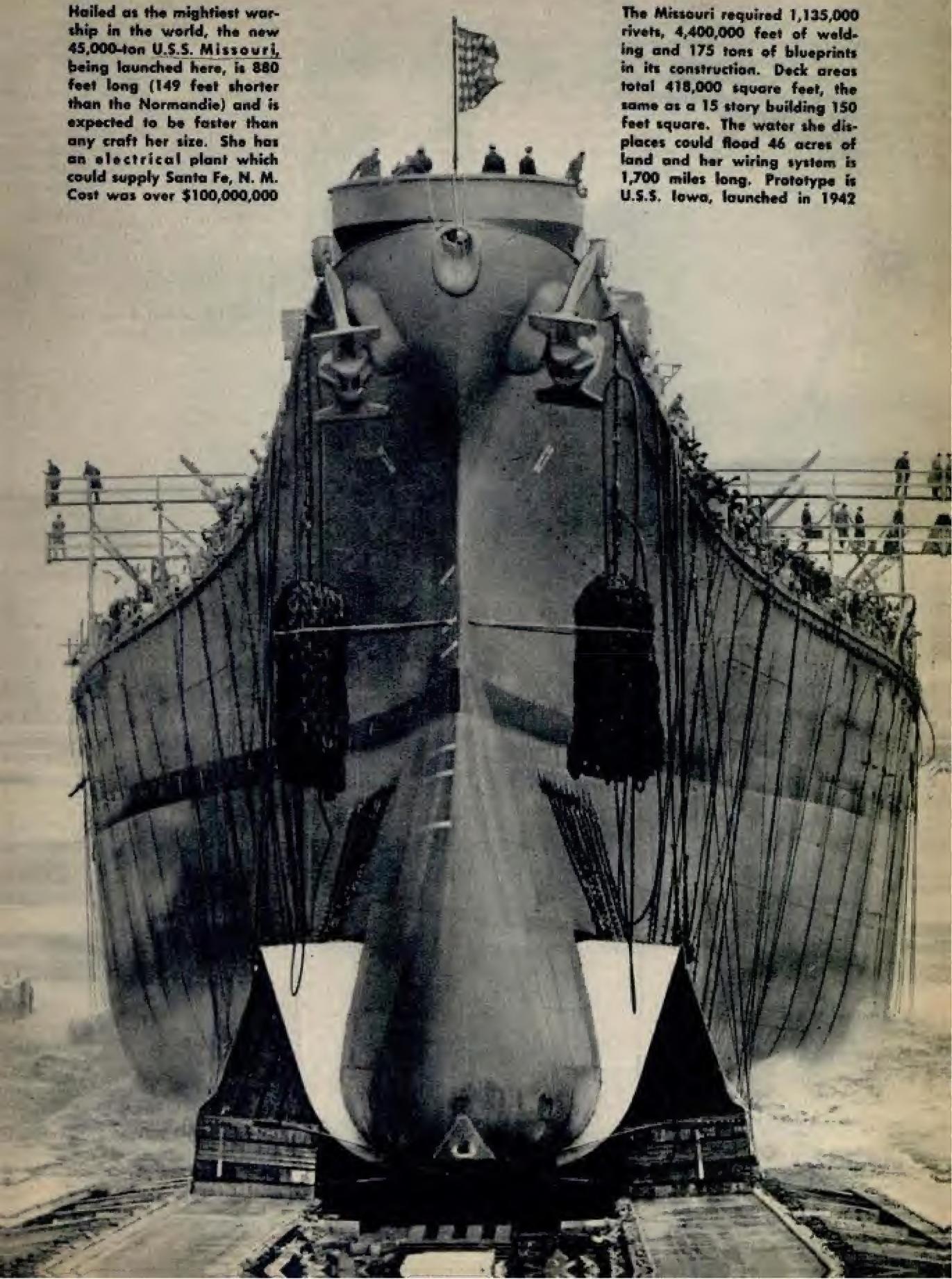


Norge Div.
Borg-Warner Corp. POPULAR MECHANICS
670 E. Woodward St., Detroit 26,
Mich.

The WORLD'S MIGHTIEST BATTLESHIP

Hailed as the mightiest warship in the world, the new 45,000-ton U.S.S. Missouri, being launched here, is 880 feet long (149 feet shorter than the Normandie) and is expected to be faster than any craft her size. She has an electrical plant which could supply Santa Fe, N. M. Cost was over \$100,000,000

O-50
The Missouri required 1,135,000 rivets, 4,400,000 feet of welding and 175 tons of blueprints in its construction. Deck areas total 418,000 square feet, the same as a 15 story building 150 feet square. The water she displaces could flood 46 acres of land and her wiring system is 1,700 miles long. Prototype is U.S.S. Iowa, launched in 1942



BUILDING BLOCKS for a NEW WORLD



cover at the corner, all owe their existence to the plentiful structural plastic—concrete.

To meet the demands of war, mountains of limestone, chalk and shells are being crushed for mixture with shale, clay or blast furnace slag, and gypsum to produce portland cement. In the first year of the war, 1.4 barrels of cement were used for every man, woman and child in the nation—a total of 182,000,000 barrels. This helped speed

Masked workman is repairing tube mill at a cement plant

THE stuff that helped pull your flier out of the mud a few years ago is helping win a war today, and at the same time playing a major role in the development of innovations that will make a more livable postwar world. It's the "work horse" of all branches of the construction industry—concrete.

Great war plants that seem to mushroom up over night, airports crisscrossed with sturdy runways, ships that are built with a minimum of precious steel, massive dams bottling up the power to produce goods of war, vast housing projects for workers, fuel tanks, and even the new type of manhole

Portland Cement Association
33 W. Grand
Chicago, Ill.



Concrete smokestack (above) is symbolic of the important part cement plays in vital war industries in the United States. Left, finishing machine moving over a strip of pavement



Slab of pre-cast bridge poised above abutments is being eased into place—a delicate operation. Below, "backstage" view of some concrete work on the Hiawassee dam in Tennessee Valley

the construction of scores of war factories, and built 27,000 acres of concrete runways that would make a flight strip 150 feet wide from Washington, D. C., to Denver. An all-time record for cement construction was set during 1942.

When building contractors were ordered to rush construction in the face of war shortages of materials and labor, they turned to concrete and new methods. In working out designs to save steel, they learned that many old building codes require wasteful overdesign. They substituted reinforced concrete for traditional steel frame construction in many industrial buildings.

In one military project involving five warehouses, a change in design to reinforced concrete saved 47,053 tons of steel. To a nation at war, this means a saving of vital metals for guns and tanks. To a nation at peace, it means factories and warehouses at lower cost.

One revolutionary type of home construction available for the postwar era starts with a concrete floor on which the four side walls of the house are cast





Gas-driven machine oils inside of cement form, tamps dirt on sides

flat, one at a time. As each wall hardens, it is tilted into vertical position with simple hand-operated hoisting equipment. Door and window frames, pipe ducts, and recesses for electrical switches are inserted in the wall forms before the concrete is placed. Methods have also been worked out for concrete houses and other small buildings which will be built of large pre-cast sections.

These designs, products of intensive research, make use of concrete mixtures that will keep out heat or cold, resist the pene-

tration of tropical rainstorms, and absorb sound. Soundproof sleeping rooms will be commonplace in the home of the future, regardless of the type of construction. Use of concrete floors with radiant heat ducts built in is also predicted.

But before we can build that cozy postwar home, there's a war to be won, steel and skilled labor to be conserved for war use, and valuable time to be saved. Efforts to conserve all three have resulted in wide use of concrete "barrel shell" and ribbed-arch roof designs. Used in war plants, warehouses and hangars, roofs of these types give long clearance between columns and can be built with a shell as thin as three inches. Time-saving trav-

eling forms have been adapted to the construction. Also, a vacuum device to draw water from the fresh concrete hastens the hardening process.

The traveling forms, mounted on wheels, are used for either walls or roof. As one section of a building hardens, they are moved forward and used again and again. With this method, one war plant covering 1,500,000 square feet was erected in 60 days.

Another revolutionary type of construction, reserved for smaller buildings and war housing, makes use of a "balloon"

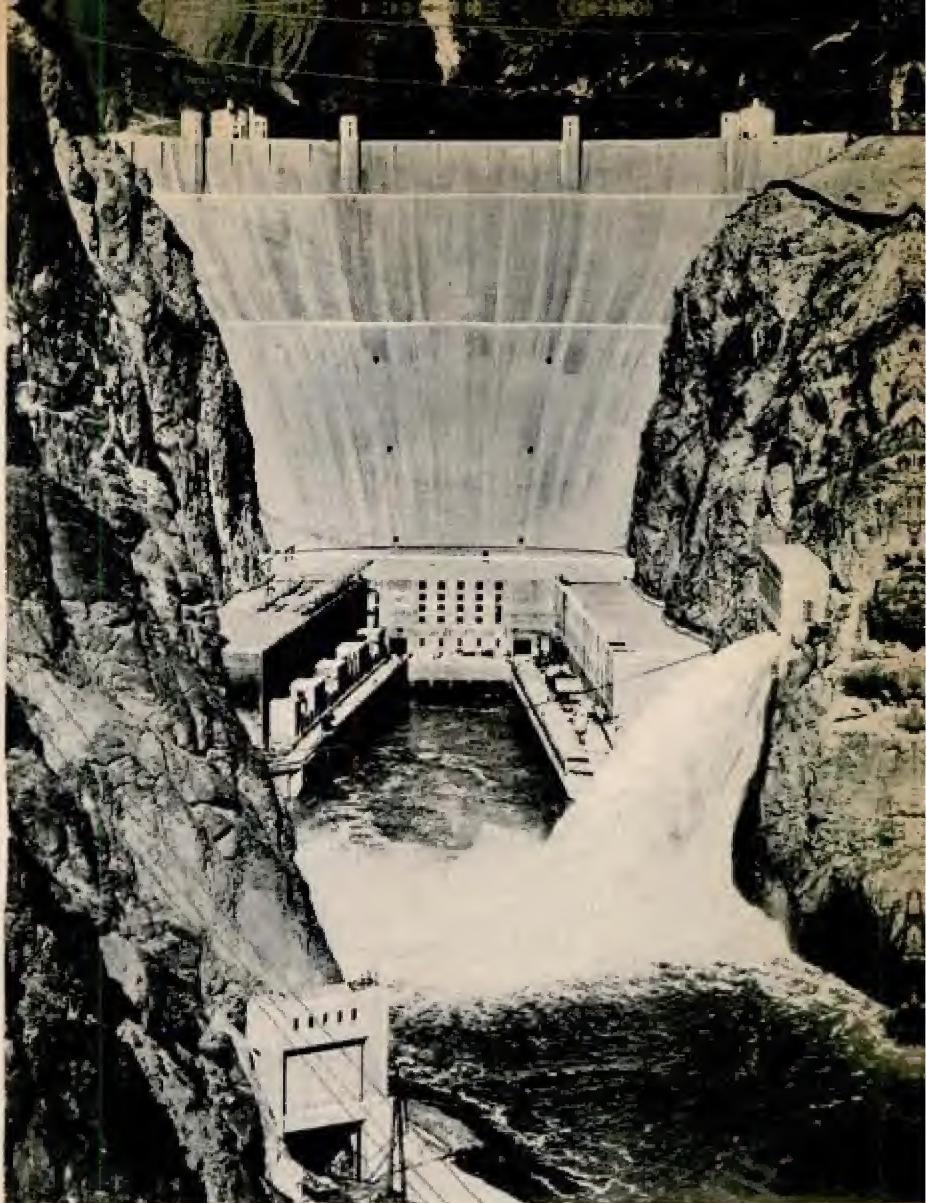
This barrel-type concrete house was "poured" in three units; interior finish is plaster on metal lath



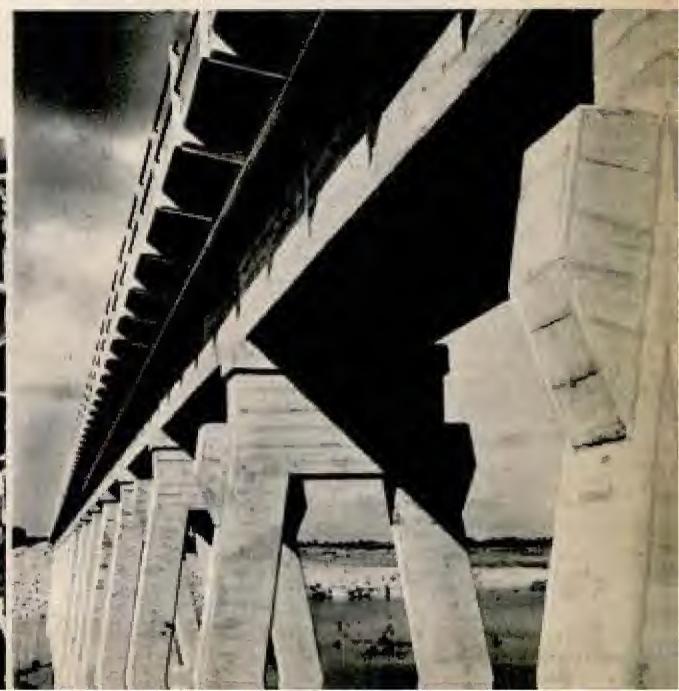
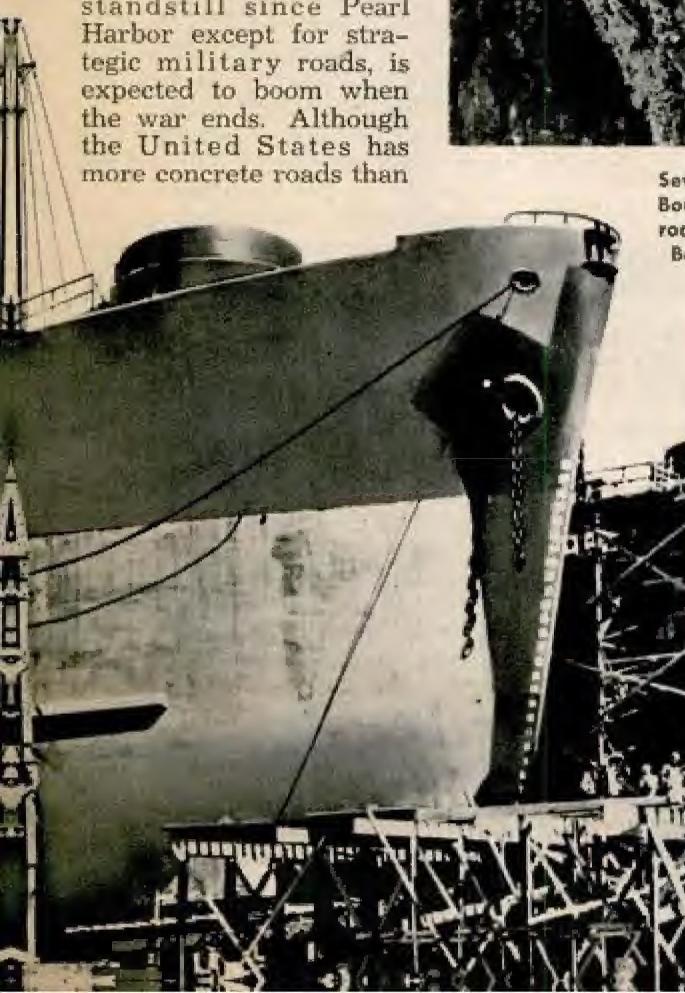
form. Concrete is placed through a cement gun over an inflated bag made of rubberized canvas or other suitable material. This forms an igloo type of structure. Wire mesh reinforcement is placed over the balloon form before applying concrete.

Knowledge gained in paving airport runways to support giant bombers will be applied to postwar highways and airport runways alike. Runways can be designed to support wheel loads of 180,000 pounds. In fact, formulas have been worked out under sponsorship of the Portland Cement Association so that road slabs or runways can be built economically to support any anticipated load. Runways should be skid-resistant and present good visibility from the air by day and good reflection for night lighting.

Highway paving, which has been almost at a standstill since Pearl Harbor except for strategic military roads, is expected to boom when the war ends. Although the United States has more concrete roads than



Seven million tons of concrete were used to build Boulder Dam which towers 730 feet above foundation rock. Left, prow of concrete ship under construction. Below, lofty railroad viaduct of unusual design

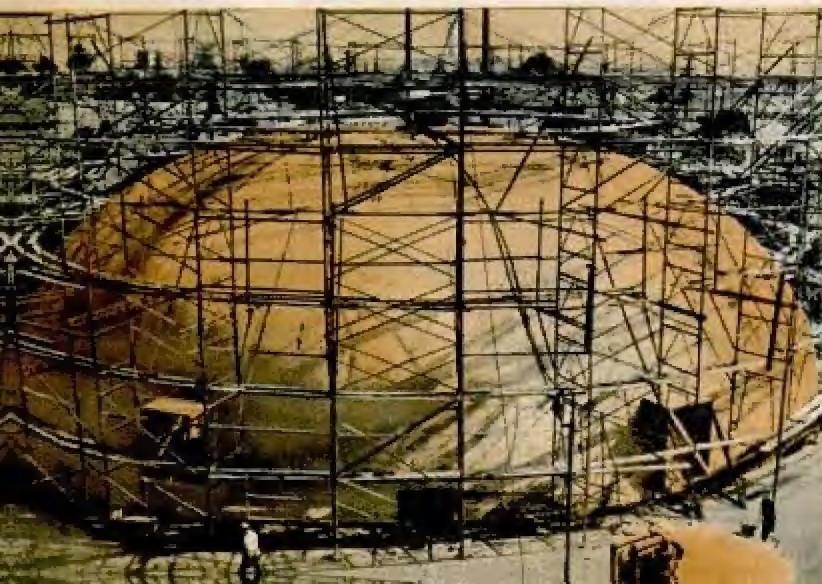




Strip of soil-cement highway gets a final sheepsfoot rolling and smoothing with scraper. It forms smooth hard-packed road



Concrete test tracks are used to check Army trucks at General Motors proving ground. Below, unique building in Los Angeles was built by pouring concrete over canvas bag filled with air



any other nation—112,168 miles as of December 31, 1940—there are still many miles of highways needing all-weather surfacing.

Soil-cement is being widely used for light-traffic roads and streets, and secondary airport runways. This pavement is made by mixing about 10 percent portland cement with approximately 90 percent native roadbed soil. Eleven million square yards of soil-cement airport runways were built in the U. S. last year. In addition, 4,500,000 square yards of soil-cement light-traffic roads, streets, and military drill grounds were constructed.

While successful soil-cement construction is dependent on laboratory and field tests developed by the Portland Cement Association, the technique is quickly mastered by contractors and engineers. The army is now training soil-cement technicians, many of whom are expected to carry their wartime jobs over into civilian life. Because soil-cement construction is a simple, speedy, low-cost process, it is expected to be extensively used in postwar improvement of many secondary highways.

Soil-cement blocks are seen as a possibility in the field of low-cost housing and small farm buildings, but experiments in this line are still in the laboratory stage.

One of the most sensational war uses of concrete to the average citizen is in the construction of concrete ships. More than a hundred ships and barges have been built or are under construction at yards in California, Florida, Georgia and Texas. Most of them are designed to carry oil. But there is nothing new about a concrete ship. Several were built in World War I, and the first one, built by a Frenchman named Cambot, was exhibited at the Paris exposition in 1855.

Concrete ships, requiring about 40 percent less metal than steel-hull cargo vessels, are looked upon as emergency vessels. They are durable enough, but their weight is greater than steel ships and they are not as maneuverable. Ship-builders do not believe many will be built after the war.

One use of concrete that will never capture a headline, but is far more important than concrete

Man-Made Storms Test Clothes For High-Altitude Flyers

ships to a nation at war, is its increased use for floors in farm buildings. In this way, concrete is helping feed the world by combating grain-hungry rats, and also saving the lives of thousands of young porkers. An estimated 30,000 concrete feeding floors for hogs built since Pearl Harbor are greatly reducing the former annual pig disease death rate which has reached 40,000,000.

The part concrete plays in the erection of great dams to store up water to produce electric power, or for use in irrigation projects, is highlighted by the war. In the field of conservation, one wartime development is an unusual type of concrete flume for soil erosion control. A stiff mixture of concrete is placed over earth shaped to the desired contour, eliminating the use of forms.

Due to the shortage of metals, new uses for concrete have developed into a mass production business. Typical examples are precast manhole covers and bases (each unit saves about 380 pounds of cast iron), concrete masonry walls to guard factories and public utilities, fuel tanks, ammunition dumps, window sash weights by the thousand, even concrete masonry storage cellars for Victory garden vegetables.

At two recently constructed military airports, 36,000 precast concrete units were used for catch basin gratings in the drainage systems, saving 700 tons of cast iron.

Concrete is helping railroads maintain roadbeds for the greatest volume of traffic in history. Cement grout, a mixture of portland cement, fine sand, and water, is forced into soft spots under the tracks to restore load-carrying capacity. This process eliminates any delay that might be incurred by rebuilding weak sub-grades.

Pinch-hitting concrete also helps lift the burden from overworked transportation facilities. The bulk of concrete materials—sand, gravel and water—is generally available locally, thus avoiding long hauls. In addition, the principles of making quality concrete are widely known. Construction crews relatively unfamiliar with concrete technique can be easily trained to turn out good work whether the project be a seven-million ton dam, such as Boulder, or a small installation to support an antiaircraft gun.

Fortunately for both war and peacetime construction, the materials for cement making are virtually inexhaustible. With the present equipment, the industry has a capacity that exceeds the demand by nearly 100 million barrels.

Symbolic of the important part concrete is quietly playing in the war, is a picture of the wheels of a Flying Fortress skimming over a concrete runway. When the last land-based plane takes off for Berlin or Tokyo, concrete will still be doing its bit to lift the bomb load into the sky.



In their endless research into the mysteries of high-altitude flying, experts of the aero-medical laboratory at Wright Field have brought the world's weather into a single room. Much of their study has to do with the proper types of clothing for the extreme cold and rarefied atmosphere of the upper air. To test the wearing qualities of a specially made raincoat, the experts had a soldier don it and submit to a barrage of weather, including man-made rainstorms, sandstorms, snow and hail.

Dayton Ohio. Ozone Fed Into Storage Vault Prevents Meat Spoilage

Meat can be protected from spoiling through an ozone treatment, according to the research department of the Westinghouse Electric and Manufacturing Company. A small but constant supply of ozone is fed into the conditioned air that is circulated in the space where the meat is stored or is undergoing tenderizing treatment. The ozone is generated preferably by an ultraviolet lamp placed in an air duct. Ultraviolet radiation converts ordinary oxygen into the short-lived triatomic molecules of ozone. To prevent the ozone concentration from rising too high, a chemically treated glass-wool filter is introduced into the air circuit, with automatic means of throwing it into or out of action if necessary.

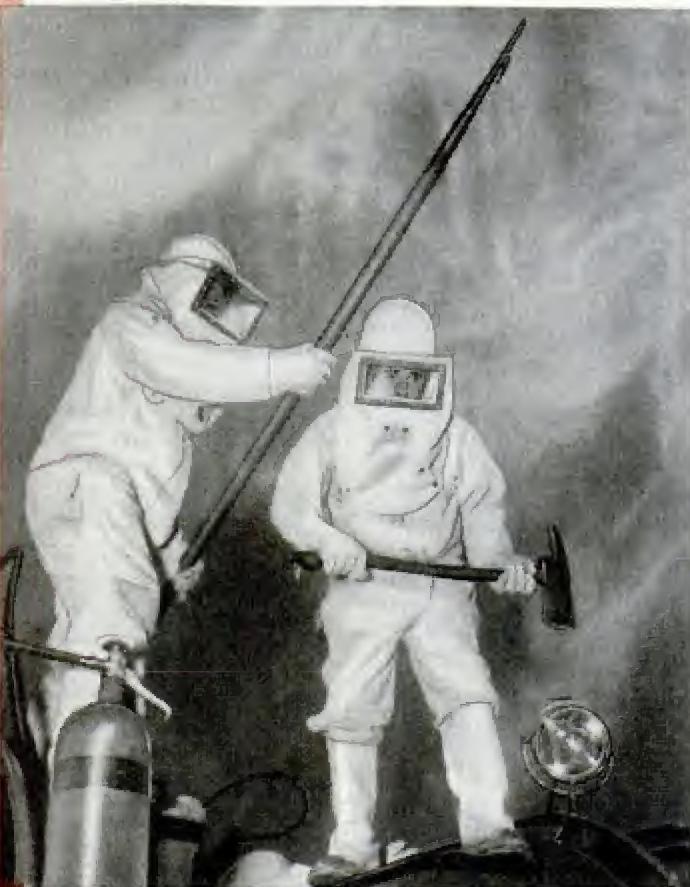
Mrs. Warren Allen O'Malley
7 Park Ave., N.Y. 16, N.Y.

SEA-GOING SMOKE EATERS

ONE of the grim lessons of this war is that fire, following the crash of shells and the blast of bombs during a battle at sea, often does more to sink a gallant ship than roaring explosives and hurtling steel.

Fortunately for our fighting craft and the fighting men who operate them, the Navy has long been aware that the changing character of warships and explosives has rendered more dangerous than ever the factor of fire. Firefighting equipment and methods were tested, manuals of instruction were outlined and training schools laid out, with the result that today the Navy has more than 15,000 flame-tested firefighters—sea-going smoke eaters—among its crews.

So many ships and lives have been saved that the Navy is considering whether giant fireboats should become parts of battle units, accompanying formations into fights and moving from ship to ship, quickly quenching blazes with multiple streams of



Above, Navy firefighters in action. At left, a Marine Corps photograph shows member of Marine-manned Pearl Harbor Fire Department descending a lifeline

water, clouds of liquid fog, or mists and streams of chemicals. Then for the first time men may see a strange sight, a firefighting ship with huge nozzles instead of main batteries; rows of gleaming water and chemical outlets along its decks, like smaller guns.

Rushing alongside a flaming battleship, the fire ship could fling scores of hoses across the burning craft, swing huge automatic booms over the smoking hatches and shell holes to dump tons of fire-throttling liquids. Vents may pour dousing mists until the burning ship and her crew are cloaked in a screen of cooling clouds. Hundreds of asbestos-clad, helmeted and gas-masked firefighters may swarm to the hot decks. In a jiffy the fire may puff away from the sooty and charred battleship in a rising cloud of vapor without even interrupting the steady crash of her great guns.

One thing is certain: if these gargantuan fireboats do become a part of battle fleets, plenty of men will be



U. S. Navy photos

A trainee at a naval school near Baltimore practices a high-level jump during fireman's school that prepares men for any emergency. Below, two officers are shown how to fight an open tank oil fire





Keeping a protective fog in front, students attack a simulated ship fire

ready to operate them, thanks to the Navy's firefighting schools at Norfolk, Boston, Mare Island, Bremerton and Pearl Harbor, conveniently located so that whenever a warship docks in the vicinity members of the crew can be sent to the school for a course of training which lasts one, three or ten days according to the time available.

Here they find most unusual classrooms which spout flames, smoke and heat; classrooms which, on the other hand, strike officer and sailor students as strangely familiar for they consist chiefly of a "mock up" of three compartments of a naval vessel. Constructed of concrete, fire brick

and steel, these compartments are models of the forecastle, boiler room and engine room of a typical destroyer. Everything except the machinery is reproduced, and in actual size. In addition to the simulated destroyer compartments, the schools have other enclosures for practice in extinguishing oil and gasoline fires. A shallow water tank is used for practice with shallow diving equipment. The tank also serves as a source of water supply when a portable pump, the handybilly pump, is demonstrated.

These ship sections have hatches, air ventilators, smokestacks, and even steel decks which become hot under the feet of the trainees or are covered with ankle-deep layers of carbon-dioxide snow as the men battle real flames with real equipment, often clad in asbestos suits.

The training devices vary at different schools. One will have a "Christmas Tree," the oil-field arrangement of pipes which spout flaming gasoline. Another will have towers from which men leap into fire nets. A third will have a unit which reproduces the sleeping quarters of a large warship. A fourth will make use of a hangarlike

Navy and Coast Guard craft pour water on blazing Navy loading depot. Not a piece of Navy freight was lost





structure in which damaged and obsolete planes are sprayed with gasoline which is set afire and quickly extinguished.

The students who can remain for the ten-day course receive thorough training. They learn about fire-extinguishing agents—carbon dioxide, chemical and mechanical foam, water, steam, fog and fog-foam. They learn about the fire mains aboard Navy vessels, about hose and nozzles, hose evolutions, water pressure, and the capacity of hose and pumps. Further, they learn about the various measures made necessary in Navy vessels by the hazards of battle.

In the conduct of the Navy's firefighting schools, theory is subordinated to actual practice. Although the students see motion pictures of fires and firefighting in progress and attend lectures, they are given many opportunities to see real fires and to participate in the work of extinguishing them. They man the hose, and handle the Navy's all-purpose fog nozzles. They put out burning oil with low-velocity fog streams. They spread foam on oil fires. They release carbon dioxide on electrical switchboard fires, and turn steam into compartments, or don asbestos suits and breathing apparatus and climb down hatches to apply water on fires in waste materials.

Classification of fires as A-fires, B-fires and C-fires does not long remain a matter of theory to the students in the Navy's firefighting schools. They see fires of each class kindled and they participate in or direct the work of extinguishment. These fires are set in the simulated destroyer compartments in order to give the closest resemblance to actual fires

Annapolis midshipmen take a firefighting course as part of their curriculum. Below, what the well dressed man wears in a blazing ship's hold





Students learn to hold hose above the hot deck, to keep hose from burning

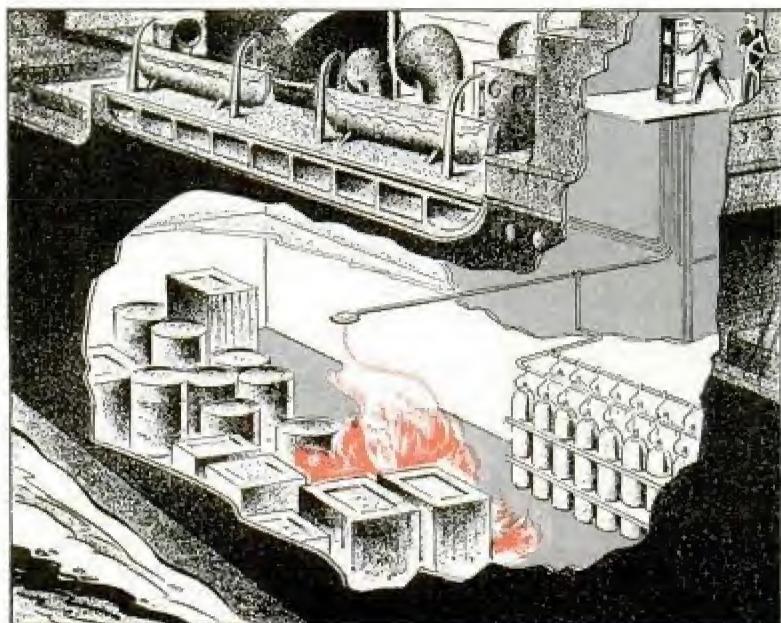
aboard Navy vessels. In these compartments all machinery spaces are indicated and passageways, vents and all other openings are reproduced; the students find conditions exactly as they would be in an actual destroyer with a fire in one or more of its vital compartments.

For the demonstration of Class A fires, waste material of various sorts, such as old mattresses, is piled in one end of the "forecastle" compartment. The pile is saturated with oil and ignited. The students detailed to extinguish this fire know from their instruction that water is the indicated agent, since the burning waste will respond best to a wetting, which brings the temperature below the ignition point. The students realize they must carry a hose line into the

compartment in order to direct it upon the fire for the proper wetting effect; they realize too that they must protect themselves against smoke and poisonous gases, and against the possibility of coming momentarily into contact with the flames. They put on asbestos suits and breathing apparatus, and climb down through the hatch, confident that they can remain below for nearly an hour, if necessary, and that their asbestos suits will afford protection against flames, and for a few minutes at a time against the heat that would otherwise be intolerable.

In the next demonstration the bottom of the "boiler room" compartment is flooded with fuel oil, and the oil is ignited. The resulting fire is a Class B fire, one that is not ordinarily to be attacked with water, since water is likely to cause such fires to spread, although in certain circumstances water may be successfully used. The students need only to look down through the hatch to realize that they are not to go down into the compartment; the entire floor space is ablaze. The students remain at the hatch. One applies fog through the hatch with an applicator to put a cover over the fire and keep down the heat so that another student can stand at the hatch and apply a smothering blanket of foam. The foam quickly builds up a sufficient depth to extinguish the burning oil. And the fire fighters have learned how to put out one of the most difficult fires, one they are most likely to encounter at sea.

Next problem is how to extinguish a fire in electrical equipment, a Class C fire. In the "engine room" compartment gasoline in a trough just below an electrical switchboard is ignited. For this fire the students know that they must use an extinguishing agent that is



Smoke from fire in cargo hold reaches wheelhouse via pipes, sounds alarm, and carbon dioxide is piped to fire by same duct
Courtesy Walter Kidde & Co.

*Electronic Specialty Co.
Los Angeles, Calif.*

Interphone for Aircraft Builders "Talks" Parts Into Place

N 965-



a non-conductor of electricity. They extinguish the fire with carbon dioxide from portable, fifteen-pound containers. Low-velocity fog would be their second choice for this fire; but they know that while the finely diffused fog is a poor conductor of electricity, it has a wetting effect, and therefore it would put the electrical equipment out of service, and would cause damage by corrosion. Water must not be used on electrical equipment fires unless it can be applied in some way that will remove danger of electric shock.

An important part of the training of the Navy's firefighting school students deals with what to do when the fire main in any section of a Navy vessel fails to work. The students learn how to resort to jumper lines that reach around ruptured sections of the main, and to set up and operate the portable handybilly pump.

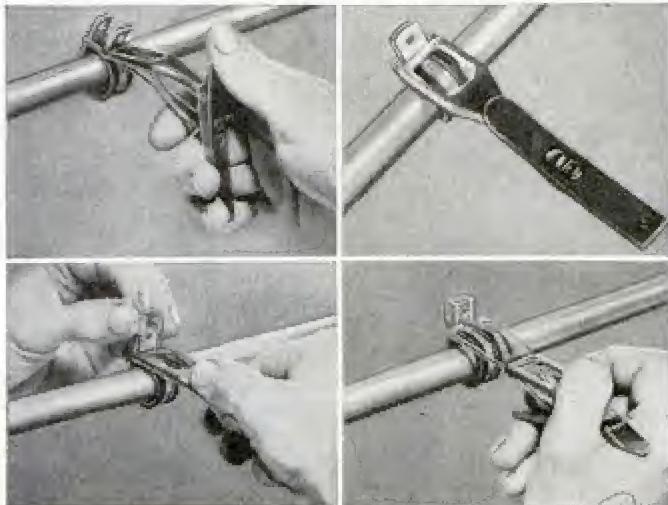
They learn to use the Navy's remarkable discovery, a cream giving protection against flash burns which rank second to shell and fragmentation wounds as a cause of naval casualties. Applied to exposed portions of the body in two minutes, it dries in five and then will protect the skin for eight hours against burns of more than 1,000 degrees Centigrade.

All in all, the neighborhood firehouse is going to be a popular place for many Navy men after the war and most of them will be able to swap yarns with fire department veterans on equal terms.

Developed for use in pilot training schools, a portable interphone has been adopted by industry to speed war production. With this unit, a mechanic working in the pilot's compartment can communicate with his assistants in the tail gunner's quarters or engine nacelle. The interphone set, complete with batteries, tubes, microphones, and headphones, weighs less than three pounds. The amplifier unit is worn around the operator's waist. Shipbuilders and companies engaged in bridge or building construction are finding the interphone helpful to foremen who can literally "talk" a section into proper position as a distant crane swings it around.

N 968

"Jack-Knife" Tool Locks Clip With Wire Over Open End

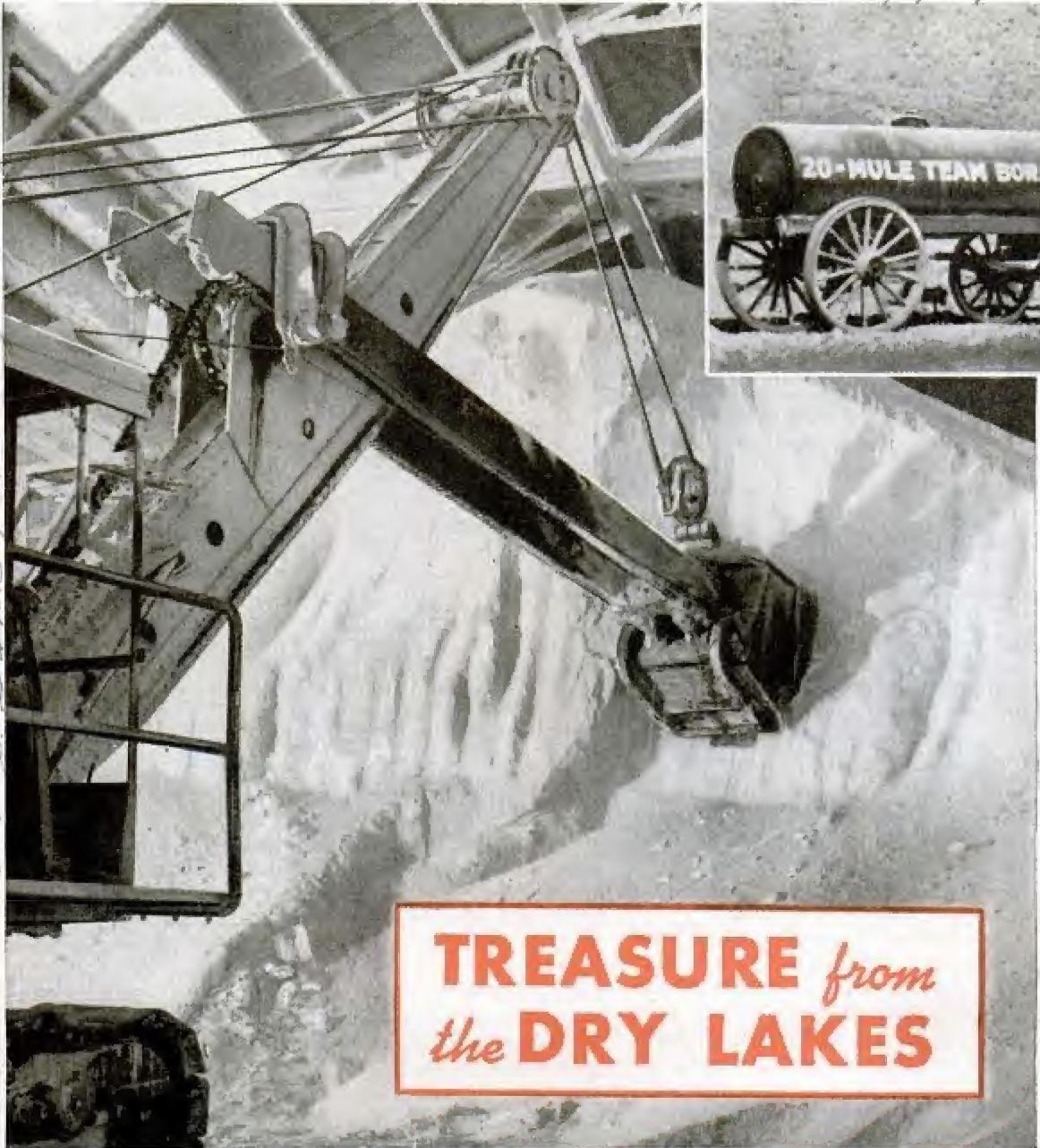


Securing clips to various parts on an assembly line is made easy with a handy pincer device that effects a temporary closure. The tool consists of a metal handle in two parts joined at a fulcrum for leverage, and a stout wire attached to the handle which acts as a pincer. The pincer is placed over the open ends of the clip and closed with an easy pressure of the thumb on the handle. A latch placed over the end of the clip holds it in place until it can be fastened permanently. This method speeds production by permitting the pre-assembly of a number of clips at one time.

*Gard Precision Products Co.
Burbank, Calif.*

77749

By: Public Relations Dept.
American Bittern & Chemical Corp.
Box 1, Standard Oil Building,
Los Angeles, Calif.



TREASURE from the DRY LAKES

Muriate of potash, one of the many chemicals found in the dried up lakes, being loaded for shipment. The demand for chemicals is so great that a pile as large as this seldom accumulates

By Thomas E. Stimson, Jr.

EVER drive a car at 70 miles per hour across a lake?

That's not a silly question.

Out in the west there are lakes where you can't swim a stroke and where boating and fishing are impossible. In pre-ration days it was good sport to test the top speed of your car on them. These lakes are as dry as a bone.

The dry lakes of the western deserts are flat, bare expanses of clay and chemicals, the dried remains of great bodies of water that existed in prehistoric times. One of

them from a distance may have the blue-gray appearance of water, and birds are fooled into coming down for a drink. Ducks sometimes make crash landings on the hard surface. Other lakes are sparkling white and look like vast sheets of common table salt. That's exactly what they are, with a few impurities mixed in.

The dry lakes are not only natural wonders but some of them, and one in particular, are fabulous chemical warehouses from which valuable minerals may be extracted. Various grades of salt are refined



"20 mule team" is hitched to wagons which hauled borax out of Death Valley in the last century. Right, mask for protection against the glare of the lake's surface

from one, soda ash is obtained from another. Borax is taken from a third.

No other of the lakes, however, seems to contain the concentrations of chemicals that are found in Searles dry lake near Death Valley in California. This one has been called the arsenal of Mars. It is yielding millions of tons of essential materials for smokeless powder, gas mask cartridges, bombsights, and radio tubes, among other things. Twenty percent of the lithium produced in the United States, 20 percent of domestic potash, 45 percent of the nation's borax, and 90 percent of its sodium sulphate, are extracted from its saline residue.

The reason some of the dry lakes are stocked with minerals is that in past eons they acted as concentration basins for salts that were leached out of the rocks by rain and were carried down to the lakes by streams. When the climate changed to its present arid state, the lakes dried up, leaving the chemicals stored in their beds. The present sun-baked surfaces of some of the lakes are 600 feet or more below their original water levels.

Many of the lake sur-

Survey party establishing section lines on the surface of Searles lake. The government holds lake as a potash reserve





Sulphate is tested in a tower laboratory set up by a chemical corporation

faces are flat enough for automobile races, others are so rough that it takes an hour to walk a mile. The "Devil's Golf Course" in Death Valley is a dry lake of this type. A test well drilled 1,000 feet deep into this dry lake pierced alternate layers of clay and salt all the way down.

On some of the lakes you can see the phenomenon of "self-rising ground." Chemical action below the surface may push the material up into reefs and hummocks four or five feet tall. Six weeks or six months later the hummocks have subsided or changed to entirely new shapes.

Winter rains sometimes flood the lakes. The dry desert atmosphere can evaporate as much as 10 feet of water a year. Some lakes, too, are moist a few inches or a few feet below the surface, with a dry top crust over which you can drive a truck safely.

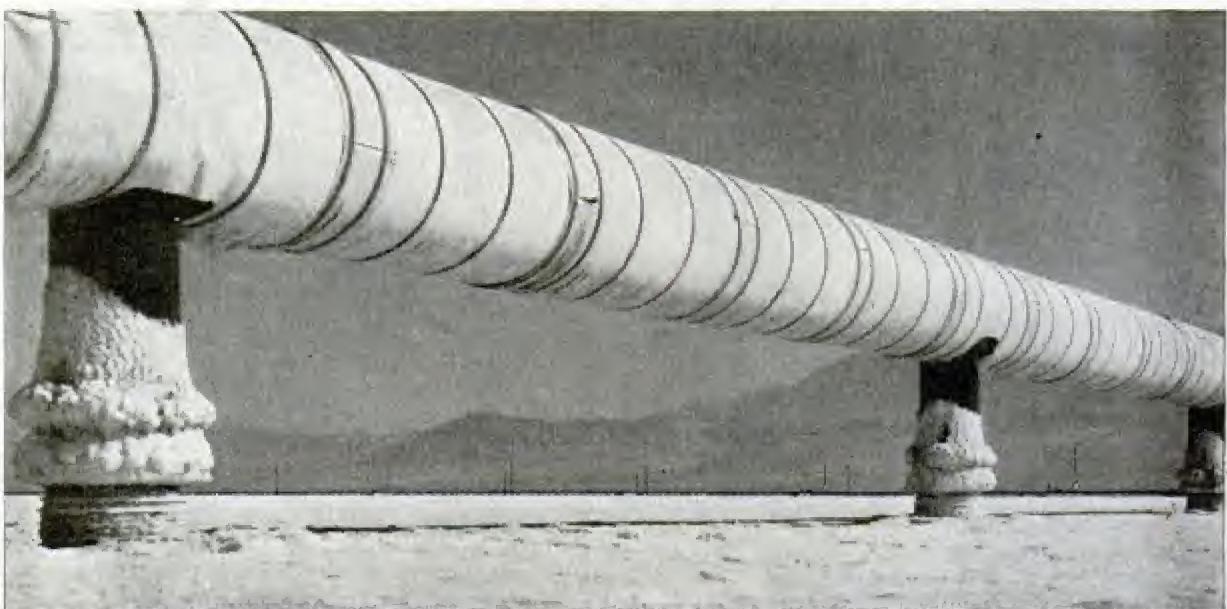
Searles lake is like that. Many thousands of years ago it was a member of a chain of lakes, joined by streams, that stretched from the present Sierra Nevada mountains to Death Valley. The odd thing is that, although apparently fed from the same source, the remains of each of these lakes contains different concentrations of minerals.

Searles has a "crystal body" from 55 to 80 feet

deep and about 11 square miles in area. Under its dry crust this mass of salt is saturated with brine. The liquid is rich in potash and lithium salts and also contains salts of sodium, boron, bromine, arsenic, phosphorus, and divers other minerals including soda ash.

This dry lake sounds better than a gold mine and it is, but like many gold mines it took a fortune and a prodigious amount of work to unlock its wealth. It is estimated that the American Potash and Chemical Corporation and its predecessors spent \$9,000,000 in learning how to separate the

Brine from Searles lake travels to American Potash & Chemical Corporation plant through a huge pipe line



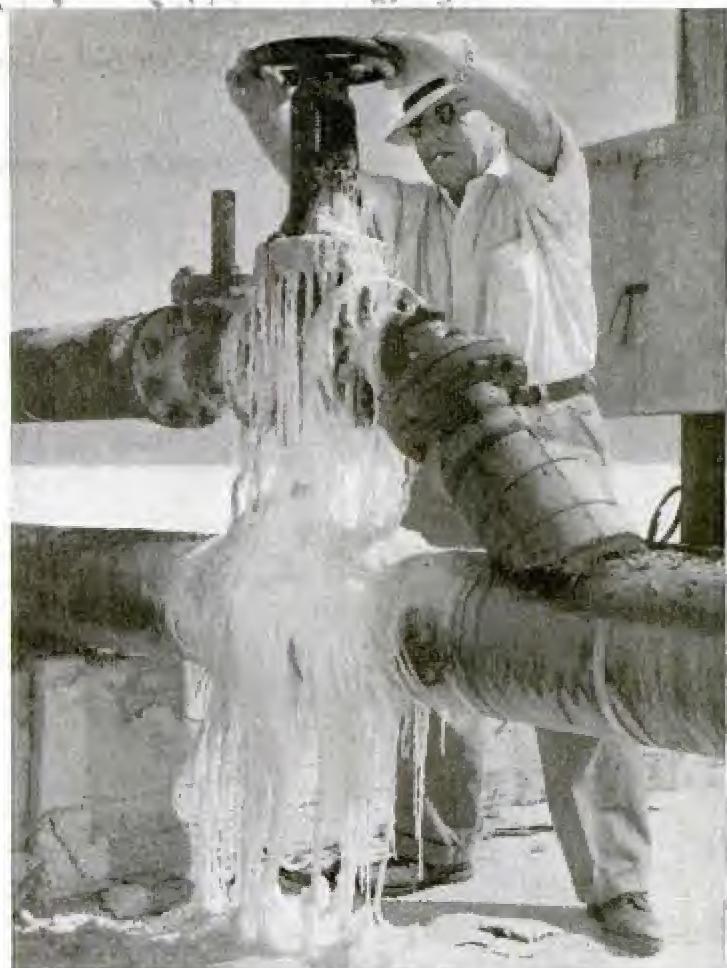
tangled-up chemicals in the lake.

John Searles, a prospector who realized some of the possibilities of the dry lake in 1862, scraped borax from its surface. Searles is said to have originated the famous 20-mule borax teams for hauling the product to market.

Later on, reefs of trona or soda ash at one side of the lake were worked because of the demand for this alkali. During the first World War, when potash was desperately needed for war uses and agriculture, the lake was developed as a source of that chemical. Gradually the steps were perfected by which practically all valuable ingredients of the crystal body are recovered.

The process consists of pumping saturated brine from wells dug into the salt mass and then subjecting the brine to a number of evaporation and fractional crystallization steps. The salts are about as badly mixed up as are the hydrocarbons in petroleum, and the extraction processes are comparable in their complexity to the methods by which crude oil is broken down into its different products. Some 15 chemicals are removed from the brine before the end liquor is pumped back into the lake.

Continued to page 154



Brine leaking from valve in the pipe line crystallizes into "icicles." Below, salt crystals have caked up on and almost buried this old automobile wheel which had been abandoned in the lake



*U. S. Rubber Co.
War-time Information Board
Ottawa, Ontario, Canada*

7820

Pilots Design "Sit-Down" Suit for Stratosphere

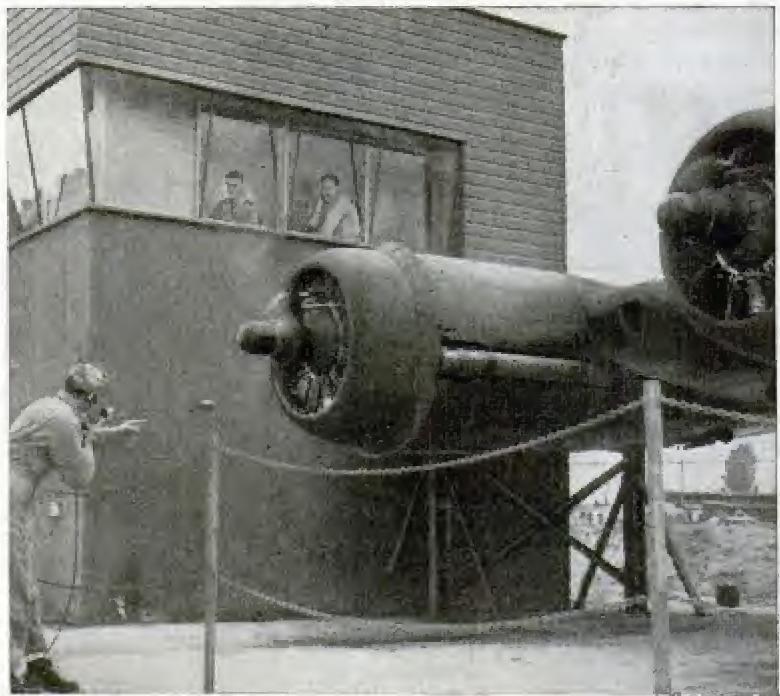


When a Royal Canadian Air Force pilot takes to the substratosphere, he has no kick about his high altitude flying suit because he helped design it himself. Four thousand questionnaires sent to the airmen resulted in a two-piece suit designed for sitting instead of standing. It bags at the knees, elbows and seat, and has zippers arranged so a man can get out of it in two seconds flat. A pencil pocket with a point protector is sewn in the left sleeve, and there is an outside watch pocket on the chest. The suit is made of fine blue twill with a loosely woven woolen lining. The gloves have bulging knuckles designed for bent fingers. An "electric" undersuit is made of cotton, and sewn into it is an 88-foot strip of inch-wide metal gauze to give warmth at 70 below zero. There are also electric undersocks.

7824

Flying Fortress Wing Is Hitched to House for Training

Casual visitors to the Boeing Flying Fortress school at Seattle might wonder if they were looking at the airplane of tomorrow, but the one-wing Fortress hitched to a house is in reality a trainer for student pilots—lieutenants, captains and majors of the Army Air Forces. The twin engines of its port wing roaring in suppressed desire to fly, the earthbound Fortress is used to teach flyers to get maximum power from the motors, and to teach Air Force mechanics how to start and warm up the engines. In the soundproof cabin of the engine run house are all instruments and controls of a B-17 cockpit.



7825

Rubber Heating Pads for Aerial Guns Avert Jamming in Sub-Zero

Jamming of automatic guns in sub-zero temperatures is prevented by installing conductive rubber gun heating pads on the machine guns and cannon of allied planes. The unit, which consists of a cotton fabric impregnated with a special synthetic rub-

ber compound that acts as the conductor, makes possible pre-heating of gun breeches while the plane is grounded and maintains required temperatures for instantaneous use at high altitudes. Current is supplied by the plane's generators.

Glenn L. Martin Co.
Baltimore, Md. 0 49

They SAID IT WAS TOO "HOT" to FLY



The Marauder is easily recognized by its tail stinger, single vertical tail fin, its relatively small, high wings set well back from the nose. The gunner in the pointed tail masts a pair of deadly .50-caliber guns.

By Roderick M. Grant

THEY called it "the plane that's too hot to fly," too heavy for human pilot to handle.

In a way, they were right. It was too hot and heavy. Not for our pilots. Too hot for the Japs at Midway and Kiska, for the Luftwaffe over the Invasion Coast.

The B-26 Marauder, born a medium bomber, had scarcely emerged from its experimental infancy when in June, 1942, it made its debut as the Army's first torpedo plane and in five critical days sank a Jap cruiser and two destroyers and torpedoed an aircraft carrier in the Aleutians, and left two more carriers burning and sinking at Midway with "tin fish" in their sides.

They were still saying the B-26 couldn't fly on its puny wings with one engine shot out when the Marauders of the Eighth Air Force in Britain began a personal grudge fight over the fighter fields of France and Holland, a fight that pretty much silenced their slanderers.





Above, Marauders race across the Channel on a bombing mission. In 4,600 sorties only 13 of the B-26's were lost. Below, the tail turret of a B-26 used to train gunners at Tyndall Field, Fla.

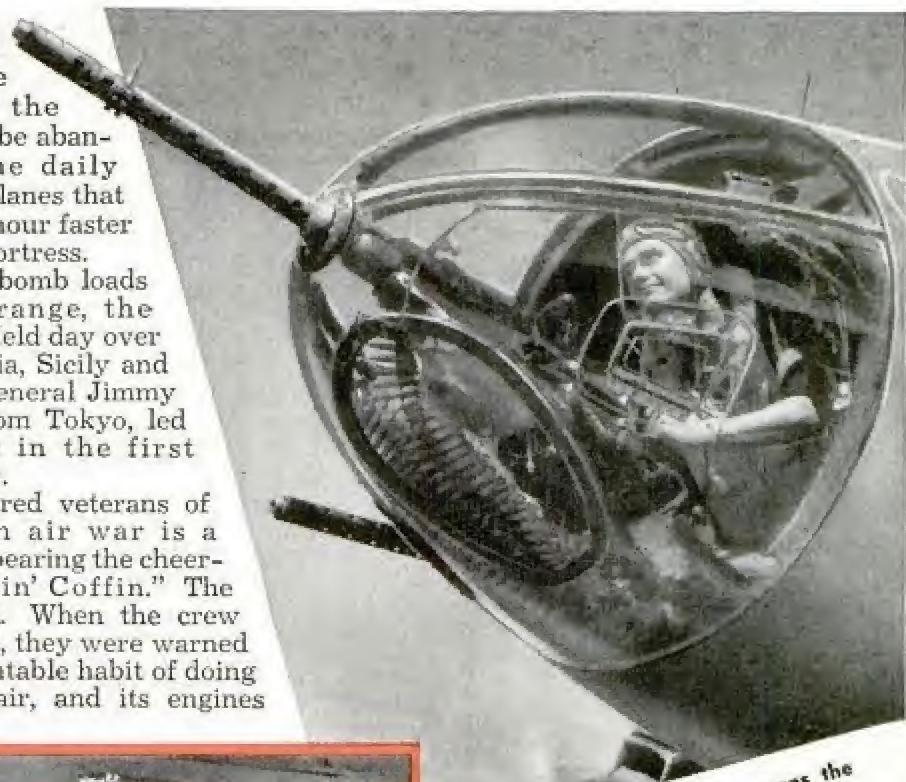
The battle got off to a disastrous start. On their first mission the Marauders flew 20 feet above the sea and ground to Velsen, Holland, and all came back alive. But from their second raid 10 planes never returned. Maybe the critics were right; maybe it was dangerous to fly, couldn't stay aloft on one engine, couldn't land safely at 100 miles an hour. A Senate committee had said so. The tacticians thought it over, took two months to retrain the crews, and sent them back over the Channel at the altitude the plane was built for.

So in July, 1943, the Marauders began a succession of sweeps that wrote one of the most amazing records of air warfare. Before the year ended they completed 100 missions comprising more than 6,700 individual sorties at a cost of only 21 Marauders—a loss of less than three-tenths of one percent, the lowest achieved by any combat group. Only three planes were downed by Nazi fighters, the Marauders shot down 31 enemy fighters, 19 other probables and 21 more damaged. They plastered Luftwaffe fighter fields, railway yards, canals, coastal batteries and arms

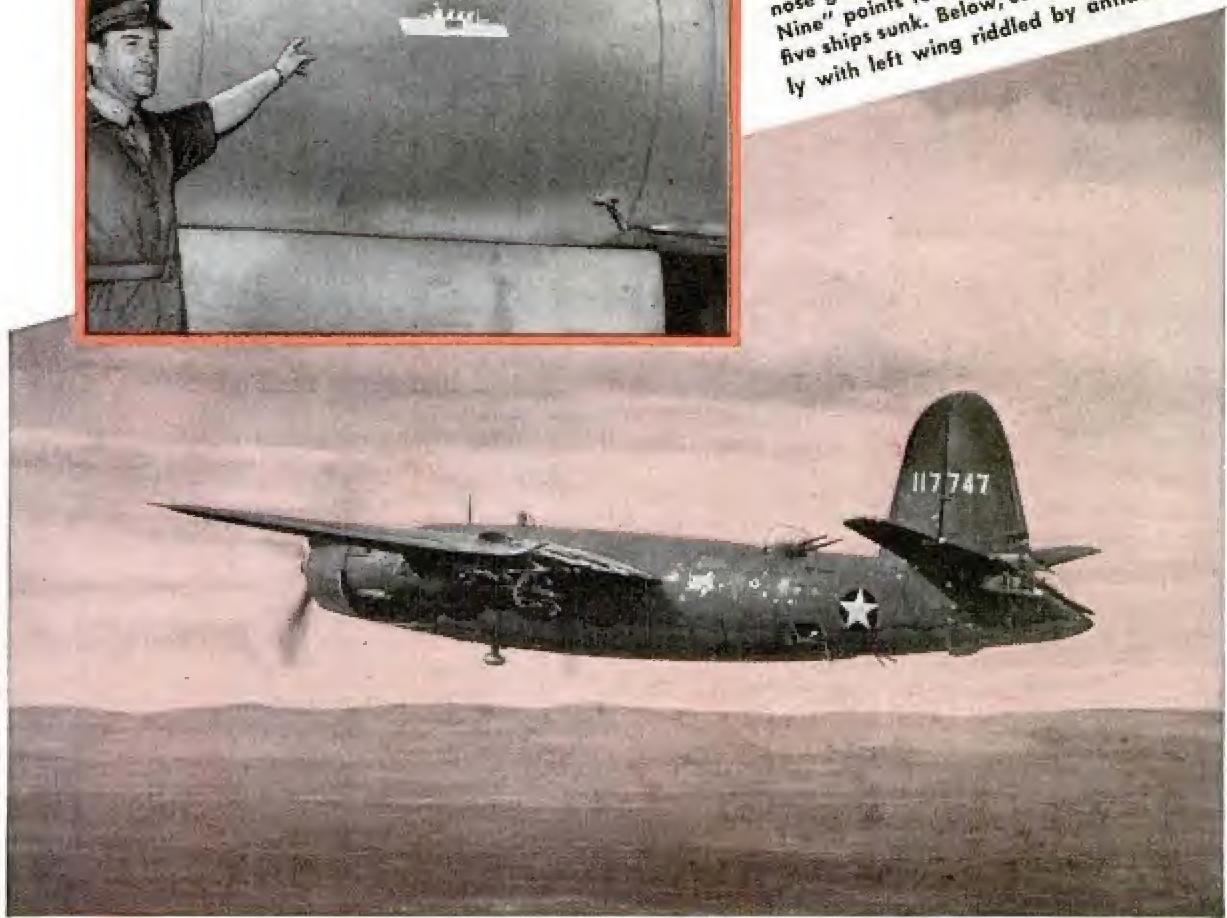
plants with 7,000 tons of bombs. Reconnaissance showed some of the Nazi fields had to be abandoned under the daily blasting of these planes that flew 100 miles an hour faster than the Flying Fortress.

Carrying large bomb loads over a 300-mile range, the Marauders had a field day over Tunisia, Pantelleria, Sicily and southern Italy. General Jimmy Doolittle, back from Tokyo, led a flight of B-26's in the first bombing of Rome.

One of the retired veterans of the Mediterranean air war is a Martin Marauder bearing the cheerful name "Coughin' Coffin." The name was earned. When the crew first met their ship, they were warned it had an unaccountable habit of doing flip-flops in the air, and its engines



The bombardier (above) also mans the nose guns. At left, the pilot of "Old No. Nine" points to his Marauder's record of five ships sunk. Below, coming home safely with left wing riddled by antiaircraft





Above, General Electric men test controls of Martin bomber turret with tracer fire. Below, preparing to install a new engine



were afflicted with asthma. Maj. William R. Pritchard of Mobile, Ala., who flew it to Africa and home again, found he wasn't being kidded. The "Coughin' Coffin" coughed like an invalid and would turn belly-up in the air like a tickled puppy.

But the "Coughin' Coffin" came home with an honorable discharge after 50 combat missions in which it shot down eight German fighters and sank three ships, one an Italian cruiser. It was cited by Prime Minister Churchill for bombing a bridge in Tunisia. Three times it had come back on one engine (they said a Marauder couldn't), and from the final trip over Sicily the "Coughin' Coffin" came home with the hydraulic system shot out, one landing wheel missing, the fuselage in tatters with 270 flak holes, and in its crash landing was wrecked beyond further combat usefulness. But in all those battles not one member of the crew received a scratch, and the "Coughin' Coffin" was able, after first aid, to fly the Atlantic and retire to an honorable career as a trainer.

At a Marauder field in England the ground crews were sweating out one of the first cross-Channel blitzes. At last they heard the roar of twin Wasps, and one by one they counted the returns.

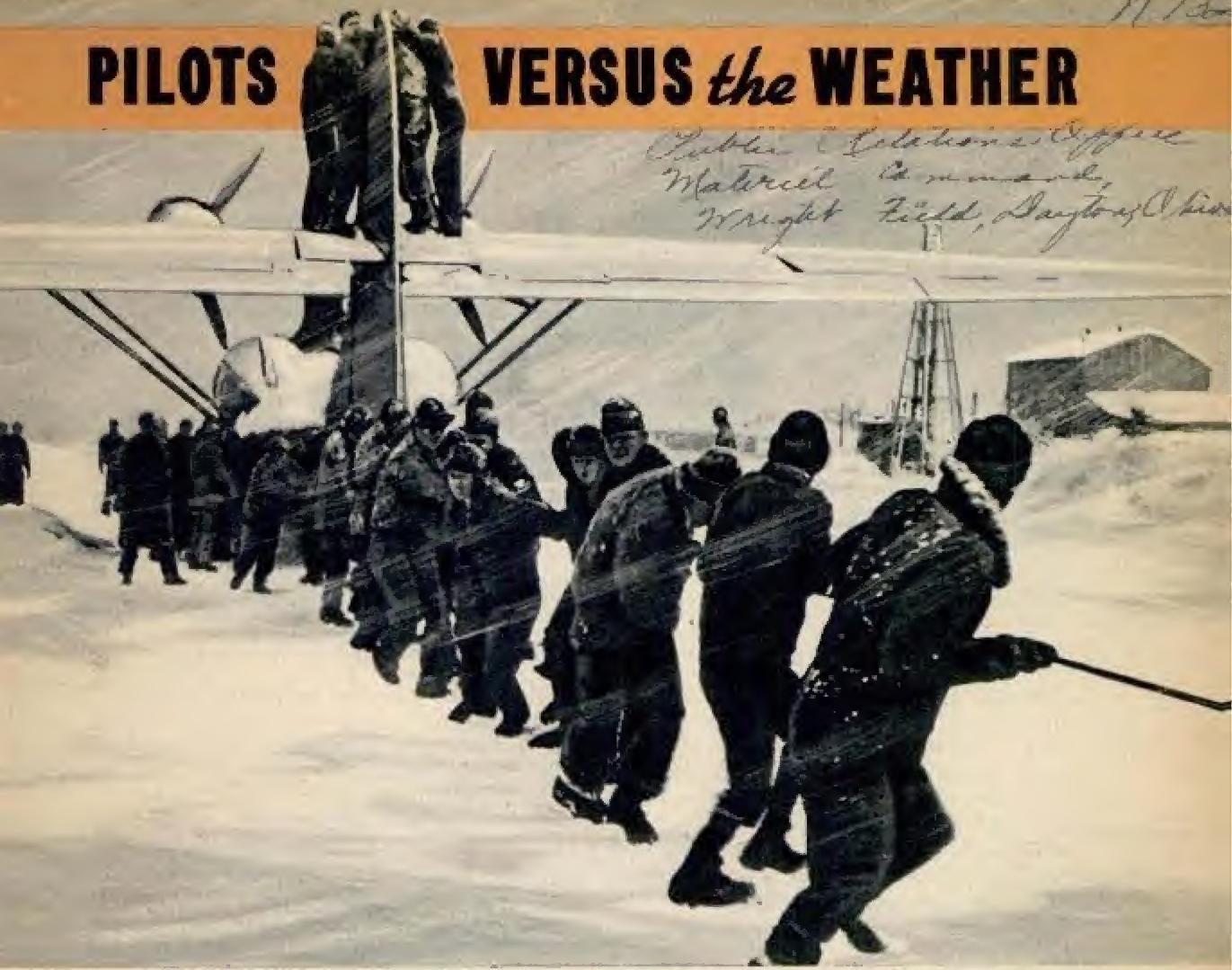
Finally the last ship, piloted by Major Celio, came over the field. A shell had blasted the left nacelle door, jets of hydraulic fluid sprayed intermittently through the open bomb bay doors, and the left wheel was stuck. The tower told him to go back upstairs and abandon ship. He kept circling. Operations repeated the order to jump, but Major Celio radioed that Sergeant Cook was on the catwalk

Continued to page 156

PILOTS

VERSUS the WEATHER

773
Public Relations Office
Material Command,
Wright Field, Dayton, Ohio



Official U. S. Air Force photo

Navy maintenance men dislodging a PBY stuck in an Aleutian snowbank. Below, weather officers brief pilots before a flight

WEATHER can make generals change battle plans, disrupt transportation schedules, force pilots to fly blind, often to their deaths. It causes all icing accidents, most mid-air collisions, many landing and takeoff crashes.

The turning of the tide of battle in Tunisia was delayed two days by a ground fog, which made it too dangerous to send bombers to hammer the Germans surging through Kasserine Pass.

No longer, however, can it be said that "Everybody talks about the weather, but nobody does anything about it." Much is being done to minimize its ill effects, especially on military aviation.

At hundreds of stations all over the world, Army weather observers probe the upper air with meteorological balloons; take note of wind velocity, humidity, and precipitation and other clues to weather's imminent behavior. Then they make weather maps





Hot air defrosts motors of an ATC cargo plane in preparation for its flight from an Alaskan base

and forecasts, which the Army Air Forces' Communications Wing, by means of the world's largest aviation radio network, supplies to stations on six continents. Here is a forecast given in a briefing session to flyers about to take off for overseas:

"Gentlemen, the course tonight will be a rhumb line. In order to top the lower layer of cumulus clouds, climb to 6,000 feet after takeoff and maintain this altitude for two hours and 20 minutes. By this time the cloud system accompanying a cold front should come into view. Fly at 2,000 feet through this front to avoid serious icing conditions, which will exist from 4,000 to 12,000 feet. You will encounter light turbulence passing through the front. Two hours and 45 minutes after departure you will have cleared this front. Then climb to 13,000 feet to take advantage of a 50-knot tail wind. Maintain this altitude for the duration of your flight. You will be on top of all cloud formations and will be able to use celestial navigation. Landing conditions at the terminal will be: ceiling, 2,000

feet, broken clouds, unlimited visibility. Alternate airports are shown on your forecast folder. Are there any questions?"

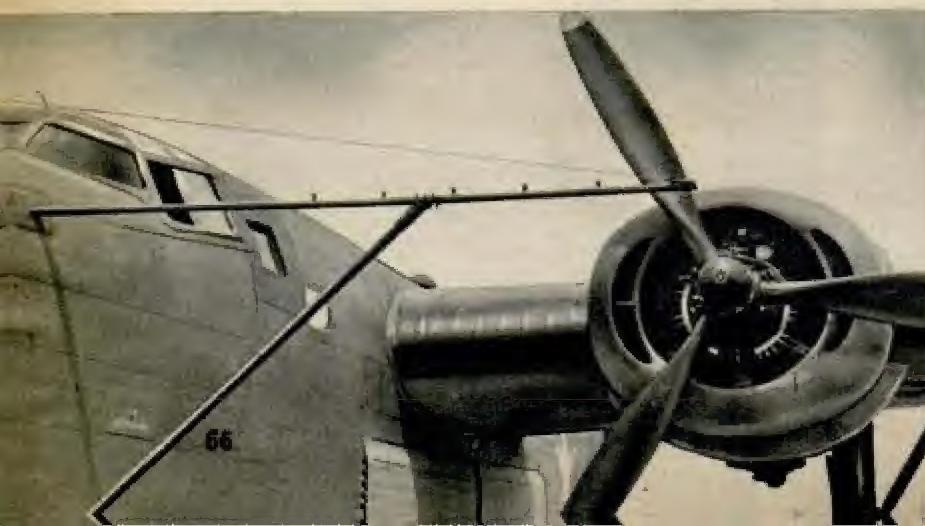
Probably not; little room was left for misunderstanding.

Warnings of sudden changes in the weather are sent to pilots in cross-country flight by means of an advisory service established by the Flight Control Domestic Wing of the Army Air Forces. Pilots plan their flights carefully, indicating the communications contacts they will make en route; reporting their exact positions at each radio fix, and maintaining an alert listening watch throughout each flight.

Meanwhile, advisory officers, equipped with flight plans of all cross-country missions within their areas, plot each flight on a magnetic map, moving the flight along according to the speed and course indicated, and checking it repeatedly against position reports from stations in radio contact with the pilot. While primarily for the purpose of relaying information about the weather, the Pilots' Advisory Service also

warns of large formation flights, revised orders, or other emergency.

What a pilot can do about the weather is a matter of common sense and know-how. Much of this comes through training—but one of the handiest places to find the best advice on the subject is



Through this outrigger water is sprayed into propeller to permit ice formation study while in air

in the new Pilots' Information File. This readable, pictorial loose-leaf booklet was revised from dull technical orders by writers of AAF's Safety Education Division.

In a section entitled "You and the Weather," the Pilots' Information File tells the flyer practically everything he needs to know about winds, rain, snow, hail, thunderstorms, down-drafts, fogs, dust and sand storms, tornadoes, and warm and cold fronts. It describes the types of clouds and the significance of each in its effect on flying conditions. For example, the File says of thunderstorms:

"Don't fly through them if they can be avoided. Turbulences within a thunderstorm can tear apart the strongest airplane. Air currents travel upward in the center of a thunderstorm and downward around the edges.

"Don't go below a thunderstorm unless the base is at least 2,000 feet above the ground.

"Do not try to fly around thunderstorms lying in lines as along a line squall. They usually extend for too great distances. If it is absolutely necessary to fly through a line squall, it is better to fly in the gray part where light rain is falling rather than in the small



Sighting on balloon with theodolite to obtain wind direction and speed

clear spaces that may exist between thunderstorms, because there is usually severe turbulence along the edges of a clear space. However, if the clear spaces are wide it is possible to go through them.

"If necessary to fly through a thunderstorm, the best altitude is about 2,000 feet above the ground where the turbulence is usually the least.

"An isolated thunderstorm, not associated with a front or the windward side of a mountain, usually can be flown around. Go around it in the direction from which

Electrically heated shoes being plugged into trouser cuffs. Below, Liberators landing in snow





Putting a B-25 under wraps on a cold night in the Andreanoff Islands.

it is coming, not in the direction toward which it is moving."

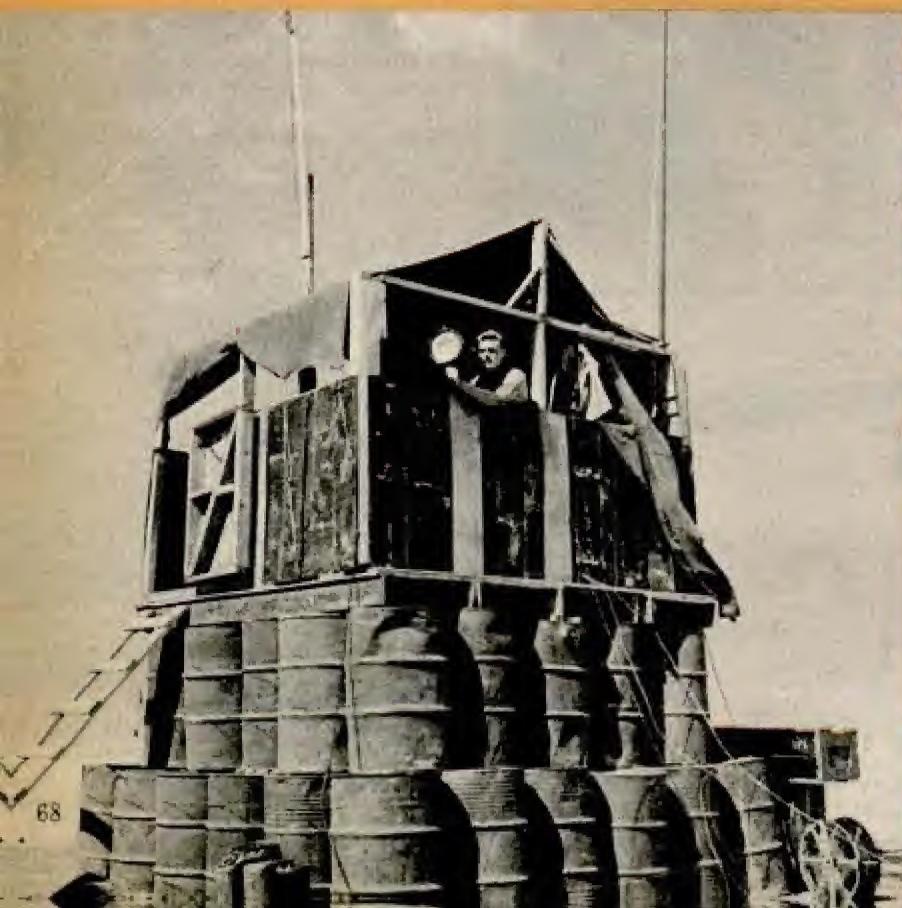
One Air Forces pilot writes of what can happen when such advice is not heeded:

"After about two and one-half hours, we became tired of dodging thunderheads, so we decided to go on through the lightest looking section of the storm. We entered at 10,000 feet with wheels down and air speed reduced to 120 miles per hour. We hadn't been in 30 seconds when the artificial horizon and the gyro compass both went out and the needle was fluctuating wildly. Our only remaining instrument that showed any semblance of being cor-

rect was the airspeed. It gave a continual reading of between 50 and 60 m.p.h. with the wheel pressed against the instrument panel. We must have held the elevators full forward at least 15 seconds before our airspeed picked up to normal. At this point we were thrown out of the thunderhead through no effort of our own, and found we had come out 180 degrees from the direction of entry, with numerous dents and a few holes in the fuselage. The ultimate solution came by way of a detour of better than 100 miles."

One of the principal hazards weather produces is icing, not only of wings, tail surfaces, and propellers, but of carburetors. Temperature generally warns when ice is likely to form on the former, but, because of the cooling effect of the evaporation of fuel after it has been introduced into the carburetor air stream, a plane's carburetor can ice when the free-air temperature is as high as 95 degrees Fahrenheit.

Formation of this type of ice is normally indicated



FRACTO-CUMULUS OR "SCUD"
(RAGGED STORM-REMNANTS)

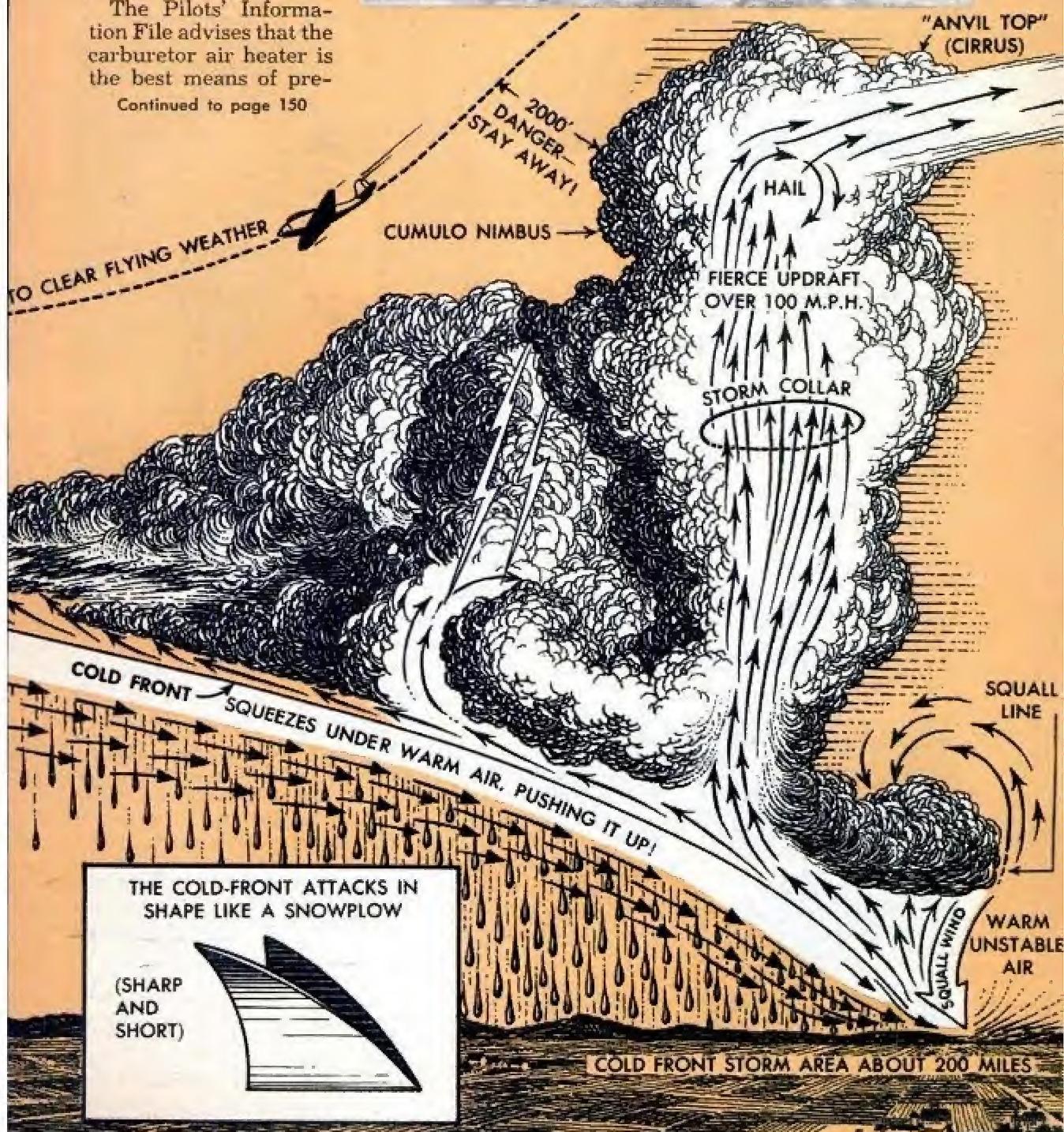
Directing air traffic in Africa from a control tower built on oil cans. Drawing of cold front storm area (right) is from the A.A.F. Pilot's Information File

Navy ground crew wades into icy water to bring in bomber

by a gradual loss of revolutions per minute, if a fixed pitch propeller is used, or a gradual loss of manifold pressure, without any change in the throttle position or the attitude of flight. Under most conditions, carburetor ice forms so slowly that pilots are frequently caught off guard, but it may form so rapidly that loss of power is abrupt.

The Pilots' Information File advises that the carburetor air heater is the best means of pre-

Continued to page 150



04

Canister on Cheek of Mask Eliminates the Hosetube



Paratroopers, infantrymen and other assault troops receive maximum protection against poison gas and a minimum of interference with a new lightweight mask. The assault service mask, developed by the Army's Chemical Warfare Service, has the canister attached directly to the face-piece, eliminating the cumbersome hosetube. When not in use, the mask is carried in a waterproof container which can be worn on the back, chest or leg.

N 960

Tester for Fabric on Airplanes Eliminates Cutting Out Pieces

Airplane fabric is tested quickly with a mechanical tester that operates like a



*Dept. of Commerce
Washington, D. C.*

spring center punch. The tester, developed by the Civil Aeronautics Administration, has a disk-like pad on one end which is placed against the fabric to be tested. When the handle of the tester is pressed down, a center plunger is driven through the pad and against the fabric with a known force. The blow shows whether the fabric is dangerously rotten, and whether the "dope" covering it is brittle. The tester eliminates the former practice of cutting out pieces for laboratory tests. It has been used in tests at 40 degrees below zero and up to 160 degrees. The internal spring is adjusted for various grades of fabric.

09

"Letter Automat" for Yank Notes Aids Writing to Servicemen

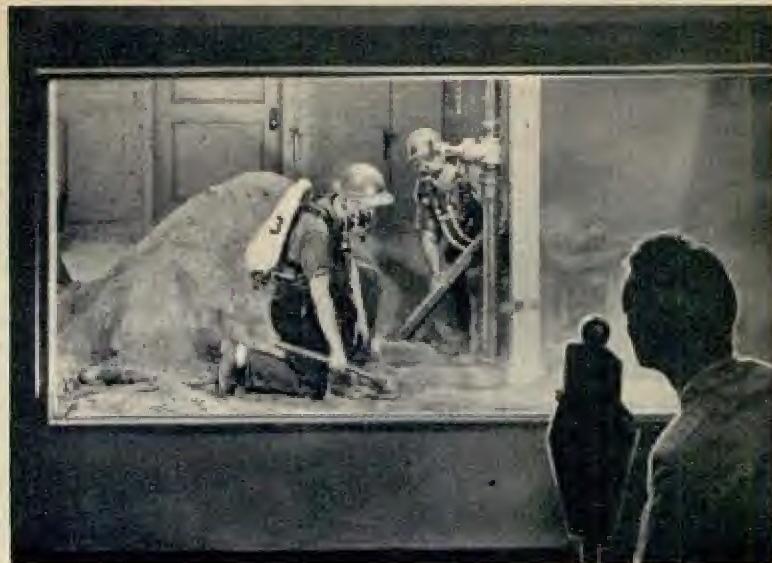


One company makes it easy for its employees to write to former colleagues in the armed services with a "letter automat." It consists of a homemade wooden desk with an opening in the top across which paper is fed from a roll of Teletype paper. Each roll provides space for anywhere from a dozen to 40 individual messages. A turn of the crank at the side of the desk rolls written matter onto a roller and brings up a clean section of paper. Biographical data concerning the serviceman to whom the letter is addressed is posted on a mail box above the desk. The "automat" was built by two employees of the Owens-Corning Fiberglas Corporation, Toledo, Ohio.

The gasoline consumed in a 1,000-bomber raid over Berlin would drive your car at 12,000 miles a year for 1,000 years.

Gas Chamber Trains Workers for an Emergency

Workers in the Bethlehem Steel company plants are learning to use gas masks similar to those used by the army. This is to protect them in emergency cases from the dangers of industrial gases used in steel plants. The training program is conducted in large chambers filled with non-poisonous, stinging gas. The trainees crawl through mock tunnels, load wheelbarrows, and repair pipes, while an instructor stationed outside the chamber directs them over a public address system.



11952



11965

Bundle Carrier on Binder Speeds Hemp Harvest

Harvesting hemp, one of America's new wartime crops, is speeded up with an improved gatherer-binder. Attached to the binder, developed by the International Harvester Company, is a carrier which swings the tall bundles out of the path of a tractor, saving the labor of one man. Formerly, the stalks were picked up, carried to the top deck of the machine and kicked out behind. Hemp is a substitute for abaca, prewar import from the Philippines and the Dutch East Indies used for making high grade rope. Hemp makes satisfactory rope and also various types of smaller cordage.

11966
McKeehan
Chicago, Ill.

"Flak" Helmets for Flyers Cover Earphones

American pilots and crews are protected against shell fragments from "flak" with an improved steel helmet that affords added protection to the neck and face. The M-4 flak helmet of square design covers a pilot's earphones, microphone, oxygen mask, goggles and head covering. A similar helmet of rounded design, the M-5, was developed for use in restricted turrets. Both helmets are products of the flying clothes branch of the A.A.F. Materiel Command at Wright Field.

11973



GRANDPAPPY of BOWLING



One of the oldest known sports, lawn bowling is increasingly popular as easy, healthful exercise.

LAWN bowling, called the "grandfather" of all bowling, is enjoying a revival of interest in this country which promises to make it a major summer outdoor sport. Simple to learn and requiring little physical effort, the game is played by persons of both sexes from 9 to 93 years old. It has a natural appeal for America's millions of indoor bowlers and lately is being taken up increasingly by war plant



Correct way to grasp bowl for good bowling

workers who are looking for easy, healthful relaxation out of doors. After the war United States servicemen returning from Canada and England, where lawn bowling is a Class 1 sport, are expected to give it another spurt of popularity.

The game has undergone a few changes since it was invented in ancient times, according to some sports historians, by shepherds who used rounded stones for "bowls." The modern tools are black "bowls," smaller than indoor bowling balls and biased on one side to allow the player to deliver a curve; and a porcelain object ball, the "jack," about the size of a billiard ball. In outdoor bowling, "alleys" are "rinks," 120 feet long and 14 feet wide. The game is started when the first player rolls the jack down the rink past the 75-foot mark, whereupon it becomes the object ball. Then the players bowl alternately and points are made by the players or teams which come closest to the jack. The game is played in innings, or "ends." In



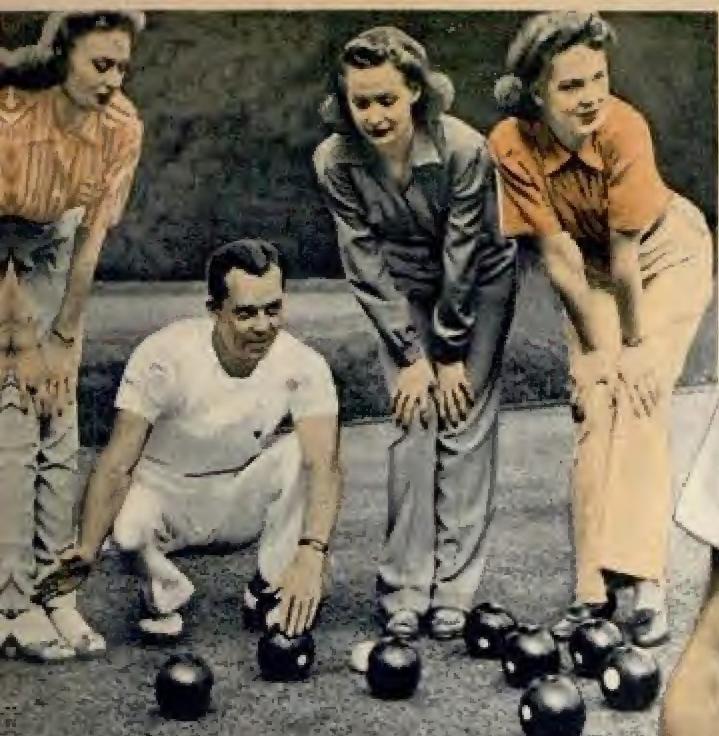
Arthur H. Hartley, national champion, measures to determine which bowls are closest to the jack
Photos courtesy Brunswick-Balke-Collender Co.
and Arthur H. Hartley

629 S. Wabash Ave.
POPULAR MECHANICS
Chicago, Ill.

McGraw-Hill Publishing Company

7760

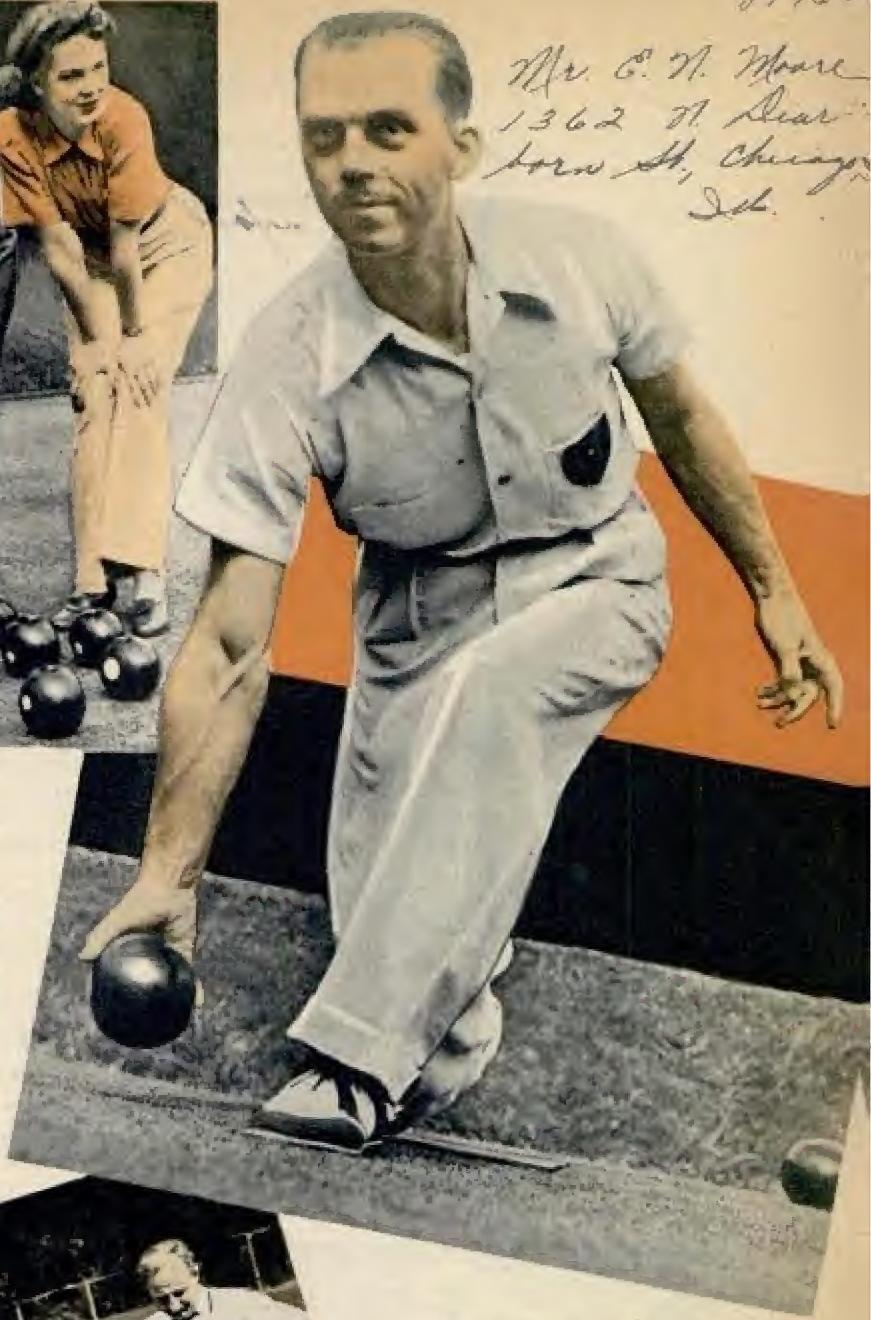
Mr. C. N. Moore
1362 N. Dearborn St., Chicago, Ill.



As beginners watch, the "skip," or captain, tells teammates where to roll bowl. At right, the proper stance and delivery

championship play a game is 15 ends but in impromptu matches 21 ends are played. Lawn bowling puts a premium on practice and a skillful woman player can play on even terms with male experts.

Needing only a small grassy plot for a rink, the game is played on college campuses, on golf courses, or in backyards.



State, regional and sectional lawn bowling associations have been organized and local leagues are continually being formed. The national champion is chosen at an annual tournament which is sponsored by the American Lawn Bowling association.

"Skip" giving directions to teammate about to bowl from the opposite end of the rink

Night Flyers Don Goggles to Acquire 'Cat's Eyes'



Night vision is improved by wearing dark goggles during the day, according to tests conducted by the Royal Air Force. Student flyers wear their goggles whenever possible, including recreation periods devoted to soccer and other games. In some cases, wearing the goggles has improved a student's night vision from 25 to 40 percent.

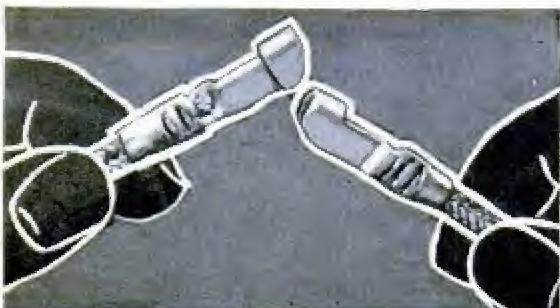
Stall Detectors to Warn Pilot With Signals in Cockpit

Two devices to eliminate the hazard of stalling, which causes over half of all fatal private flying accidents, have been developed by the Civil Aeronautics Administration. In both the pilot is warned of an approaching stall by the sounding of a horn and the flashing of a light. In one method these signals are actuated when the airplane reaches a certain angle and the air flow is reversed. This forces a vane which projects from the leading edge of the wing to move upward from its position in normal flight, thereby closing a switch. In the other instrument, pressure reversal sucks a diaphragm upward and forces an attached metal plate against electrical contacts. A cutout button will eliminate horn noises when radio reception is desired.

Solderless Splice for Wires Can Be Quickly Uncoupled

Joining of wires is made easy with a splicing terminal that consists of two identical parts. The parts lock together by means of a knife-switch principle, eliminating the need for soldering. Tubing holds

the splicing together and prevents uncoupling. The connection has great tensile strength for pulling on the wires tends to make the coupling tighter. The splicing can be uncoupled in a jiffy.



Allis-Chalmers Mfg Co
Springfield, Ill.

77976

'Fox Hole' in Artillery Tractor Holds Gun Crew and Shells



Heavy artillery is moved into front line positions with an 18-ton tank-type military tractor that provides an armored "fox hole" for the gun crew. It also carries in-

itial rounds of ammunition and is armed with a .50-caliber machine gun. The tractor pulls heavy artillery through hub-deep mud and over rough terrain at high speed.

Wood Is "Spot Welded" By Radio Gun

With a little glue and a radio-frequency gun, thin sheets of wood are "spot welded" together to facilitate handling while being shaped into aircraft parts. Formerly, the wooden sheets were held together with staples which had to be removed afterward. The current in the gun travels about one-sixteenth of an inch and its length of application, controlled automatically, determines whether the wood is to be merely tacked together or permanently set. Radio-frequency gluing, now limited to handling small parts, may be used in the manufacture of automobile bodies in the future.



77953

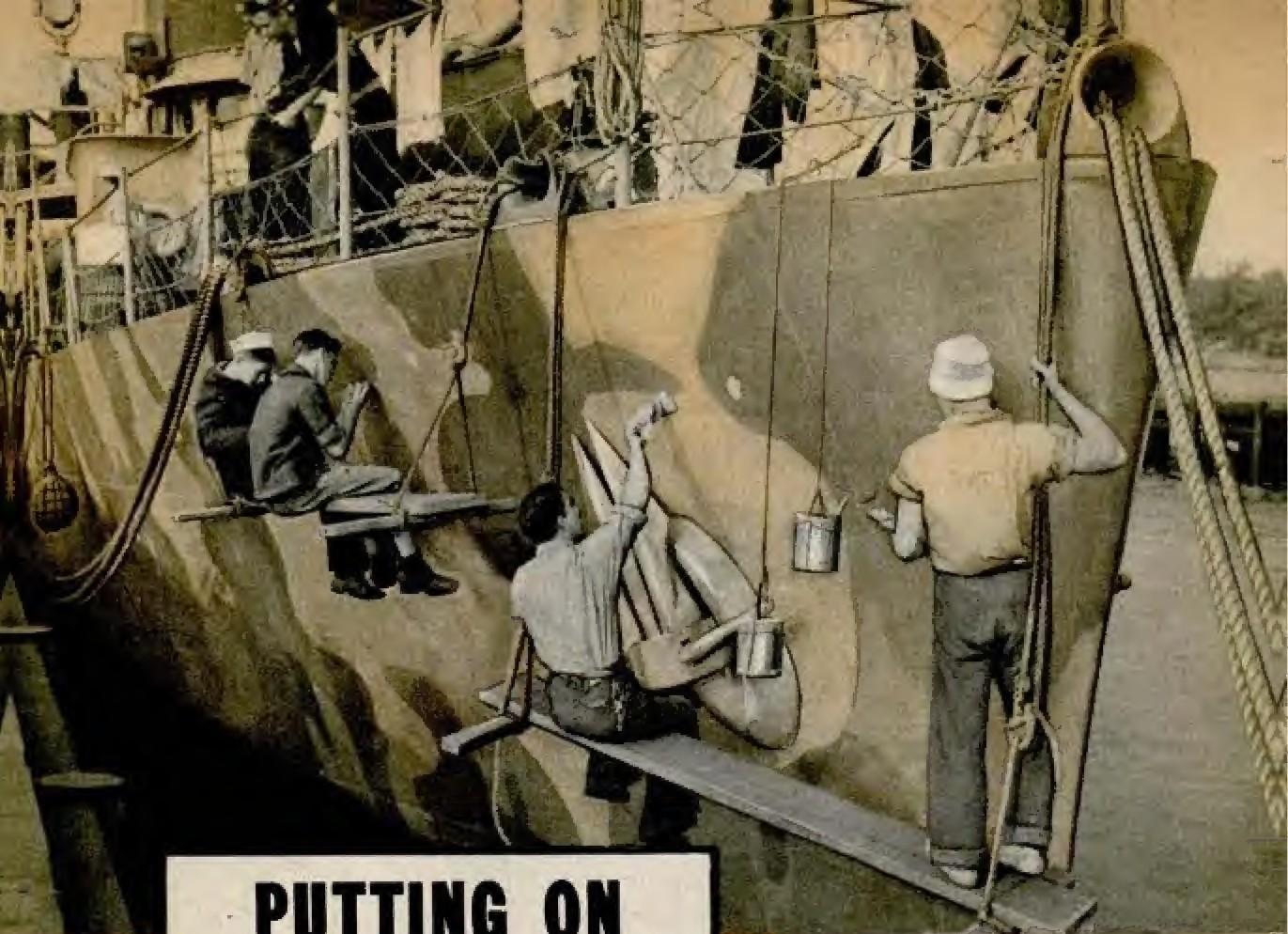
J. C. Winter Assoc.
Radio Corporation of America
Cincinnati, Ohio



Paper Dial Identifies Ship Lights As Aid to Navy Trainees

To train seamen in quick identification of the running lights of ships, a handy paper dial has been introduced. On the upper circular card are the outlines of a ship, perforated with small holes indicating the position of lights on masts, cabin and deck. As the card is rotated, yellow, red and green spots show through the perforations, and an arrow points to a number on the rim by which the lights can be interpreted from a printed guide on the back of the dial. An advantage of the device is that it indicates not only the combinations of lights, but also their relative positions on a ship.

The Forest City Bookbinding Co.
Cayton Bldg. 75
Cleveland, Ohio.



PUTTING ON *the* WAR PAINT



U. S. Navy photos.

Above, four sailors camouflage a PC boat before it goes sub-hunting. Left, putting war paint on a big gun of U.S.S. Arkansas

ONE of the most obvious things in this world is paint. It hits our vision so constantly that we seldom notice it.

Yet, without paint, we might as well halt our war effort and sue for peace. Without paint, our tanks would soon rust into uselessness. Our warships would be slowed down by barnacles until they would be soft touches for faster enemy vessels. Our uncamouflaged planes would be sharp targets for antiaircraft guns.

One classic example is the naval engagement in which a British battleship encountered a German craft of the same general class. After a slugging match, the British ship had the German vessel ready for the kill. The German ran for it and escaped—only because its hull had been recently painted and the British craft had been at sea so long it was encrusted with barnacles. The difference in speed was just enough to save the German battleship. A few

Mr. Elliott

27797

thousand dollars worth of paint was worth \$30,000,000 and the lives of a lot of crewmen.

This couldn't happen today, thanks to one of the hundreds of new discoveries in paint and its application since Uncle Sam rolled up his sleeves and began fighting. What scientists have learned about putting on the war paint will affect our post-war lives more than we can anticipate.

During the last war, we were all in the same boat—so to speak—with regard to the problem of barnacles on ship hulls. But the Navy and the Fish and Wild Life Service of the Department of Interior developed plastic paints distasteful to barnacles and other marine growths which were attaching themselves to sea planes so plentifully that they often cut the takeoff speed in half and made it difficult to lift a plane from the water. Naval vessels often accumulated 300 tons of fouling material between paintings.

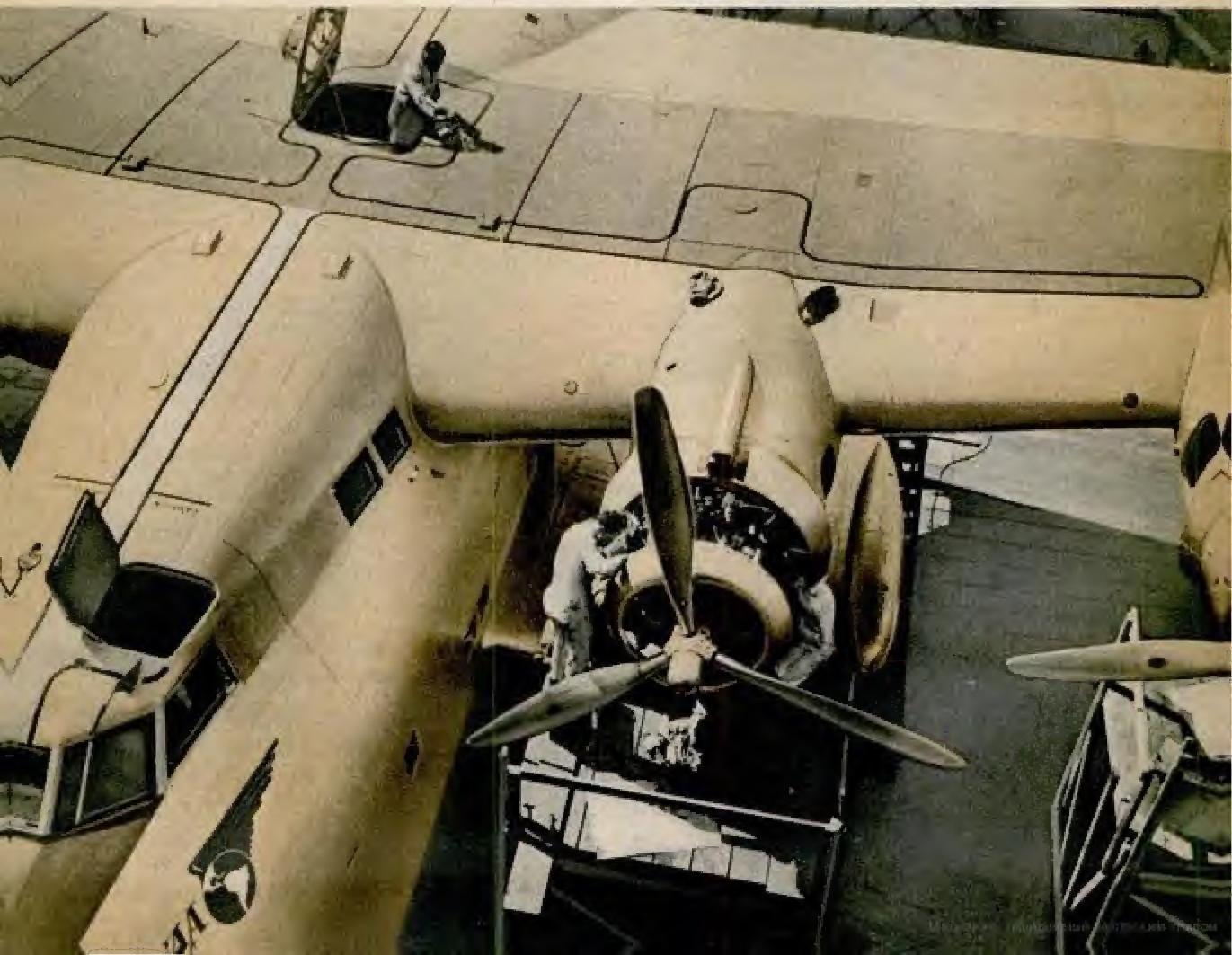
Dr. H. F. Prytherch, a government marine biologist, found two



U. S. Marine Corps photo

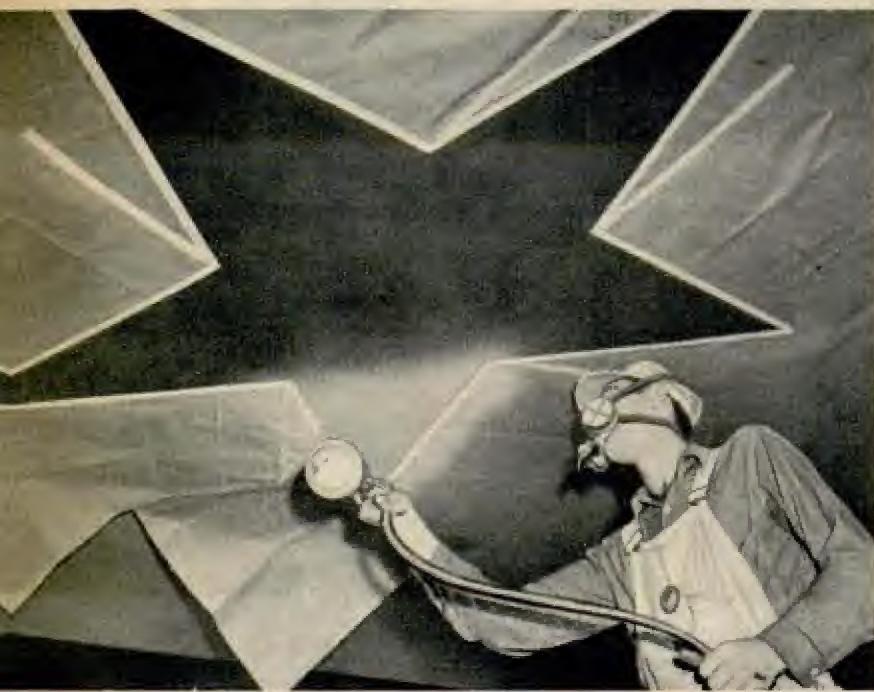
Even hand grenades wear camouflage suits. Yellow paint was too easily spotted in the jungle, and here grenades are being repainted green. Below, camouflaging a Pan American Clipper

John Winter 1944, Pittsburgh, Pa
12 S 14 d M





Spraying paint on anchor chain of a U. S. Maritime Commission ship



Painting the white star of the U. S. Army Air Force on a Flying Fortress. Below, spraying airplane cylinder heads in Studebaker plant



paints which reacted on the marine creatures like purple paint on a parlor wall. The Navy found another. The barnacles have stayed away from our ships ever since.

*Postwar use of "ghost" paint to illuminate and decorate the walls of your house will bring startling effects, thanks to new things learned about phosphors and ultraviolet light which were stimulated by wartime research on airplane dials, blackout signs and lights of low reflecting character.

Ultraviolet beams from hidden fixtures playing on phosphorescent paints will not only enable you to change the hue of a room's walls by the flick of a switch, but varicolored designs can be applied to the walls, in wallpaper patterns if desired, by changing the color-reaction, the tone and the thickness of phosphorescent paints. And the room of the future need never be entirely dark, new paint being able to store up enough energy from daylight to last through the night.

In fact, an instantaneous flash of bright light like that from a photoflash lamp is sufficient to charge a phosphor-coated wall for as long as nine hours with cold "firefly" light. These phosphors act like storage batteries, soaking up a great quantity of light and then releasing it in small amounts over a long period. A room coated with phosphor chemicals will, when highly charged, emit illumination about equal to moonlight, according to Westinghouse lighting engineers.

Postwar fluorescent fixtures may be made of pressed wood coated with a new enamel which reflects more light and eliminates the chipping suffered by porcelain-coated steel. A very white flat paint has been found to cause a hot water radiator to emit 95 percent of the heat instead of sending 25 percent back to the boiler, as happens in the case of conventional metallic paint.

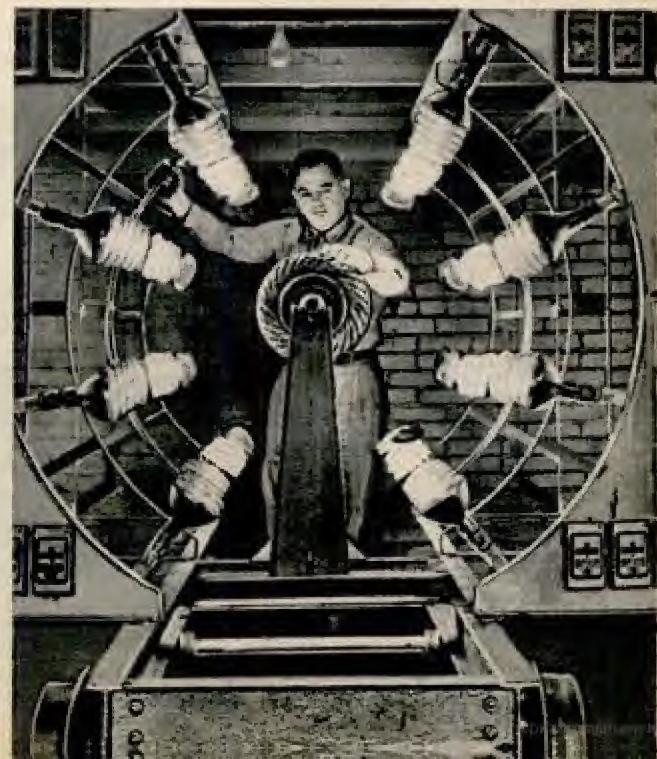


It's spring cleaning and painting time on the U.S.S. Ranger, veteran of our aircraft carrier fleet

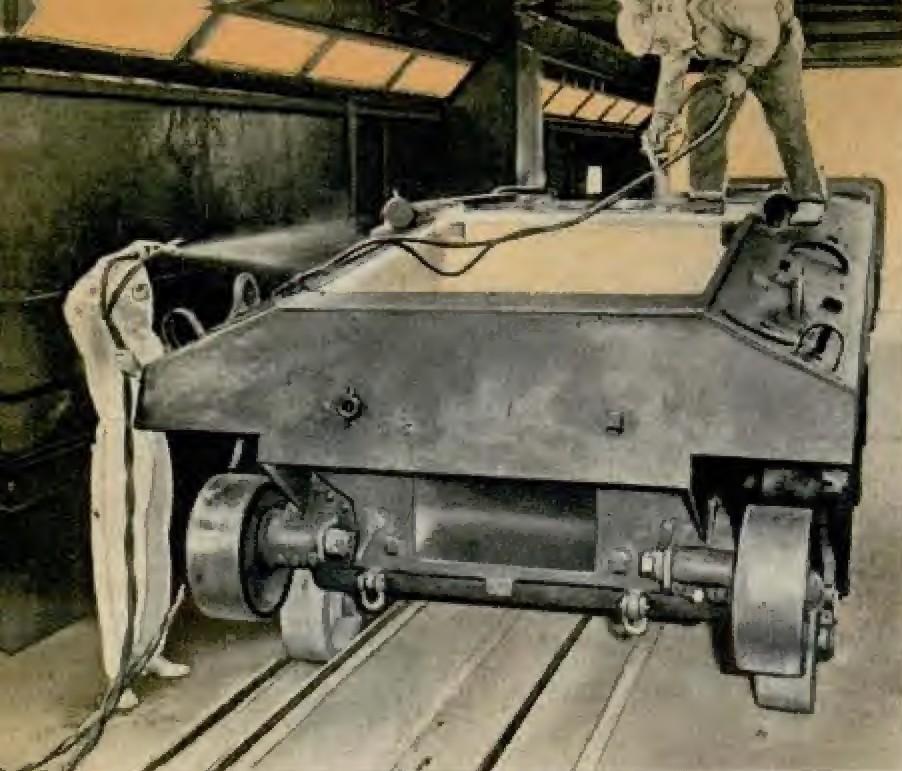
War research has stepped up efficiency of infrared methods of drying paint until a vehicle which once took a whole day to dry can now be dried in four minutes.

A new fireproof, abrasive war paint, employing finely crushed semi-precious stones such as garnets, will provide a non-skid finish for home and factories. It was developed by Goodyear Tire and Rubber Company for the Navy to prevent sailors from slipping during battle. At present, the ground garnets in their synthetic resin binder paint are being applied with spray guns on the flight decks of plane carriers as well as on gun emplacements, decks, passageways, landings, stairways and in officers' and crews' quarters for Navy warcraft of all kinds from battleships to submarines and PT boats. Tests have shown it can withstand forces up to 7,000 pounds per square inch. Its thickness is

approximately ten times that of ordinary paint film, and yet it dries completely in eight hours. It resists cold, heat and the corrosive actions of oil, grease, salt, soap and similar materials.



Infrared lamps speed the drying of varnish used in reconditioning electric motors in a mine locomotive repair shop
Westinghouse photo



An M-4 tank gets a white interior, an overcoat of olive drab paint

The laboratories of companies like Du Pont, Westinghouse, Sherwin-Williams, General Electric, RCA and Devoe and Raynolds have been working in close unison to supply the Navy, which uses more than 50,000 carloads of paint a year for ships alone. A battleship like the new U.S.S. Iowa requires 400,000 pounds of paint, of hundreds of varieties. A white, fire-retardant paint used for the interiors of cruisers and battleships won't burn at temperatures which melt many metals.

With our vessels scattered around the globe, the job of shipping paint became important. So paint scientists produced concentrated paint which can be thinned with gasoline, naphtha, or even water, despite the saying that oil and water never mix. After the war you will be thinning out oil paints with water for such jobs as painting over wallpaper.

An interesting activity in the merchant marine is the painting of eyes in the bows of ships, a custom started by the superstitious Chinese in ancient days, to protect the craft from the perils of the deep which it needed eyes to see. Also novel is the fact that the name of each new Liberty Ship is painted on its bow before launching, and then is promptly painted

Some of our new cargo ships follow the ancient Chinese custom of painting eyes on the prow to ward off perils of the ocean

U. S. Maritime Commission photo

out, since these vessels plow the seas in complete anonymity.

The seagull is the pattern for the painting of most of our seaplanes, blue on the underside to blend with the sky and blue-gray to match the top feathers of the bird which nature protectively colored to merge with the seas below. Where the plane flies over jungle, the upper side is likely to harmonize with the foliage. If a plane is to be shipped on the deck of a vessel, it is likely to be painted blue-gray for the voyage and repainted at its destination according to the locality to which it is assigned. Training planes are usually finished in bright colors to prevent collisions and to make the craft easy to distinguish against the ground if forced down.

The coloring of airplanes is relatively simple compared with the problems of getting the right paint on the right surface, since metals, plywood and fabric are often used in combination on the same craft, and what works on one surface is useless on another. On aluminum alloy plane parts, it is necessary to protect the surface with a thin film of the pure metal to produce the



General Electric Co.
Schenectady, N.Y.

Turbine With a Sense of Touch
Controls Air's Temperature

1901

aluminum oxide that serves as an invisible coating on each kitchen pot and pan. But this thin skin of aluminum in turn must be covered with a "shop coat" during manufacture or it will be scraped off, permitting the alloys to develop faults and holes.

The paint which goes on fabric parts not only shields them from sun, rain and air, but acts as a shrinker, drawing the fabric as tight as a drumhead.

Paint for plywood planes and parts must permeate the wood so that it will not be warped by moisture.

In addition, all these paints must resist gasoline, hydraulic brake fluids and de-icing compounds.

Paint also crawls across the extended battlefronts of the world on tanks, tank destroyers, jeeps and hundreds of vehicles. Here protection against the elements is necessary and defensive camouflage is applied according to the scene of operations. Since these vehicles must not only merge with jungle and desert, but snow, ice and mud, the job is a complex one. In one case a tank surface must be glossy to reflect sunlight. In another, dull to prevent reflection. Finishes must resist bitter cold and torrid heat and the cutting action of desert sand which will often polish the paint off in a few days.

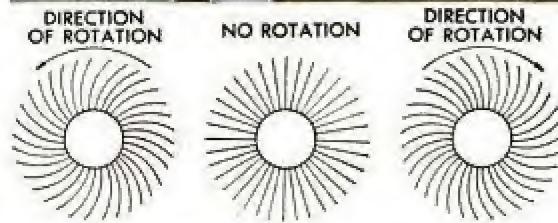
Even the simple quality of dullness was a problem. Though paint men could produce a finish with very poor ability to reflect light, it was discovered that it made a great difference what angle the light came from. A dull coat would not reflect a dangerous amount of tell-tale light from the sun, a searchlight or a flare coming from almost directly overhead, but it might mirror brilliantly a beam striking at tree-top elevation. Du Pont chemists were given the task of developing a method of measuring the reflectance factor of dull paints at all angles of incidence. Today a secret device does this quickly.

Thousands of puzzles were encountered and solved with paint. Steel landing mats in the mud of Aleutian airfields quickly turned red with rust. They served as flaming beacons in the slanting rays of the sun, guiding Jap bombers. Du Pont solved this one with a finish that could be swiped on mats already laid.

Army engineers desired camouflage paints for bridges and field installations. Other varieties of coating were needed for steel wool, glass wool and unusual concealment materials. Trees cut for camouflage purposes soon wilted and turned brown, exposing the very spot they were intended to hide. A preparation was concocted which, when sprayed on, kept them green.

On the factory front, Du Pont developed

Continued to page 154



Control of the temperature of ducted air in any installation is claimed for the "Temp-Turb" temperature control, an air-operated device which is sensitive to heat and cold. Its direction of operation is dependent on the temperature of the air that operates it. Flowing air—for instance from the air scoop in a moving plane—energizes the turbine blades. These are bimetallic similar to a thermostat—and so reverse their direction of curvature as their temperature goes above or below a fixed control point. When the air is at the temperature of the control point the blades are straight, so no rotation is produced. Increasing the temperature curves the blades in one direction, and decreasing it makes them curve the other way. The direction of rotation is dependent upon the curve of the blades. The action of the "Temp-Turb" opens or closes the shutters of the heating unit and thus keeps the temperature of the flowing air within specified limits.

Hot Oil Dip Keeps Eggs Fresh

Fresher eggs for Mrs. America's table may result from a discovery at the University of Missouri. Eggs were dipped in hot mineral oil, which seals shell pores and kills bacteria, and remained fresh after 45 days of room temperature storage. The Army has tested the process under hot desert conditions.

C. D. du Pont
Public Relations Dept.
Wilmington 98, Del.



"TAXI SKIPPERS" of the



Exploding mines and a hail of machine gun bullets fail to stop Coast Guardsmen landing the "amphibs"

AN ARMY officer stepped from his amphibian craft onto the white beach of a South Pacific island. He surveyed the camouflaged military beehive on the fringe of jungle torn by machine gun fire. The officer, who was looking for marine headquarters, approached a group of men in khaki pants and shirts who were struggling with an oil drum.

"Say, marines," he called, "could you—" "We're not marines, sir," one of the khaki-clad and perspiring members of the group replied, "We're members of the Coast Guard."

A little farther on, the officer encountered two young men stripped to the waist and wearing sailor's pants.

"Say, Navy," he said, "could you direct me—"

"We're members of the Coast Guard," one of the young men said, "but if you're looking for marine headquarters, sir, just take that trail to the right."

The Army officer wasn't nearly as surprised to find the Coast Guard entrenched on a South Pacific island as Americans at home would have been on hearing the news. Many persons still think of the Coast Guard as dashing up and down the Atlan-



An invasion rehearsal held off shore of Pacific island

Mr. Wayne Whittaker

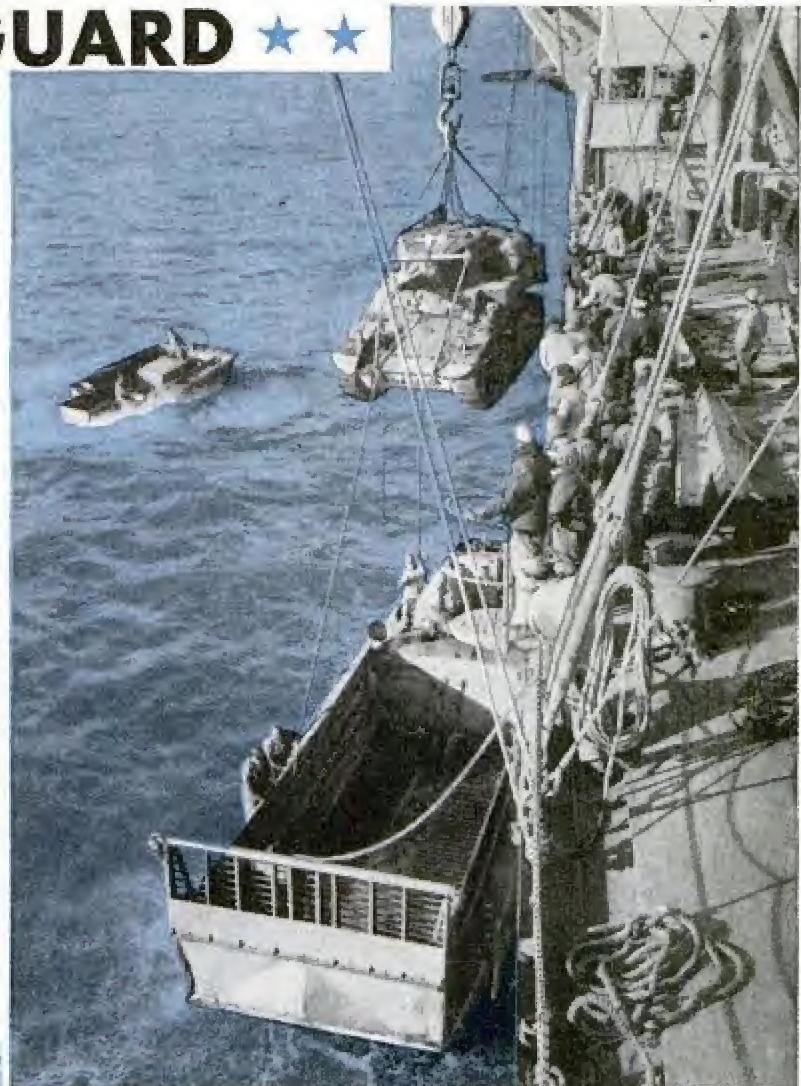
71622

COAST GUARD ★★

tic or Pacific coasts in cutters, or convoying merchant vessels. That is just part of the Coast Guard's farflung war activities. Since America went on the offensive, one of the Coast Guard's biggest, most important and by far its most dangerous task, has been landing assault troops of the American Expeditionary Forces on hostile enemy beaches. Once the actual landing operation is accomplished, the landing crews don't scurry off to transports out of range of enemy guns. They stay within walkie-talkie call.

Working as an interlocking arm of the Navy, often in mixed crews and in close co-operation with the Army's Engineer Amphibian Com-

Tank is lowered over the side of Coast Guard-manned transport. Below, testing gun in the snug cockpit of invasion barge





Amphibious "duck truck" piloted by Coast Guardsmen races through surf

mand, officers and enlisted men of the Coast Guard have collected a sky full of bronze stars to wear on their medal ribbons, testimonials to their performance of duty under enemy fire.

In the glare of searchlights on Gela Beach in Sicily, and at many an island landing in the Pacific, members of the Coast Guard and their fellow amphibians of the Navy held their exposed stations in landing craft while bullets spattered the sea. More than one trooper has yelled to the coxswain piloting his boat to get down or he would be shot. The reply is always the same:

"We got to land you guys in the right place and we can't do it in the bottom of the boat."

After the assault troops are set ashore

to clear the mine fields and barricades, and wipe out machine gun nests, the "taxi skippers" shuttle back and forth bringing infantry reinforcements, ammunition, big guns, tanks and mountains of supplies.

The ramp-loading landing craft operated by the Coast Guard and Navy crews at Gela ranged from 36-foot troop carriers to the huge LCT boats (Landing Craft for Tanks) and the medium LCM (Landing Craft for Mechanized Equipment). A number of small craft were crippled by enemy shells before the amazingly accurate fire from warships silenced shore batteries and knocked out enemy tanks (one cruiser bagged 14 big German tanks).

The boats that could limp back to their mother transports, which at the initial stage of operations were stationed about five miles off shore. One Coast Guard captain on board a transport answered all questions about what to do with the crippled craft with the terse retort:

"Pull 'em up. Pump 'em out. Patch 'em up. Put 'em back."

In the Sicilian action, Coast Guardsmen were in charge of every type of vessel with the exception of the regular Navy fighting boats—battleships, cruisers and destroyers. One Coast Guard officer who was at Gela Beach, Lt. Blair Walliser, said the crews on landing craft worked from 24 to 48 hours

A "wave" of invasion barges circling their transport waiting for precise moment to start toward beach





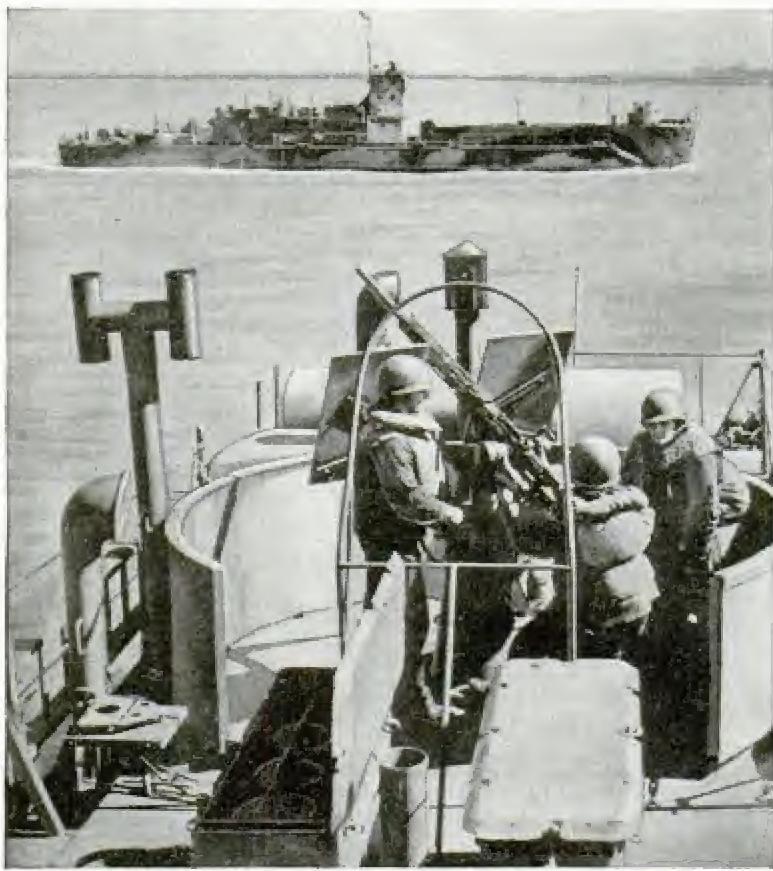
without stopping. Their food consisted of Army emergency rations.

"Despite the continuous bombing and strafing attacks by Nazi planes," said Lt. Walliser, "and the heavy fire from Italians on shore, our men kept those landing craft rolling onto the beaches in a continuous tidal wave. Before the shooting started, the Italian searchlights kept wavering over the invasion fleet and then flickering away in a mysterious fashion. We found out later from Italian prisoners that at first they thought we were part of their own fleet setting out on a secret mission."

The Coast Guard and Navy crews who distinguished themselves in the Sicily invasion, as well as in Africa, the Aleutians, Tarawa, and other South Pacific islands, received expert training at amphibian stations along the Atlantic and Gulf coasts. The men studied every

Troops huddle in bottom of landing barge as it speeds toward the shore. Below, mine explodes on the beach to lend reality to practice landing





Coast Guardsmen man "battle station" on barge leaving camouflaged ship

type of landing craft, often under instructors sent from the shipyards that built them. They learned how to operate the gasoline and Diesel motors and how to repair them in an emergency. They were also taught to man the guns on the taxi fleet. The number and caliber of guns on any type of landing craft are Navy secrets. One type of landing craft they use is carried in several pieces and assembled on the transports. This saves 80 percent in shipping space.

During practice landings with the ramp-loading boats, the men learn the dangers of a sidewise landing in a heavy surf. The boats, which can poke their noses almost up on a sandy beach and back away with ease, must make a straight approach. If they are caught in the surf and swept sidewise they are almost helpless.

"The morning we landed troops on Guadalcanal

Rubber rafts like this helped marines make shore at Tarawa

we knew just what to do and where to be thanks to those maneuvers," said one coxswain. "The men on the transports first put our barges, together with us skippers and our crews, over the side. This took about 15 minutes. We quickly warmed up our boats—just as we had done many times along the Atlantic Coast—and cruised around the ship to the cargo net where we loaded the marines. Then we kept close to the transport until there were enough barges to make a 'wave'."

When a detachment of assault troops, supporting units and supplies are landed, the work of the taxi skippers has only begun. While the mother transport goes about her business elsewhere, the skippers and their small craft are often left on the beachhead with the attacking force. Their busi-

ness is to bring in supplies that may be sent along later on merchant vessels, and they are ready on a moment's notice to support the troops in any action.

John H. Coppens, boatswain's mate first class, a veteran of the Battle of Guadalcanal where he helped land the first marines to go ashore, tells the dramatic story of rescuing 800 men trapped on a beach-



head 10 miles from Henderson Field. This was six weeks after the initial landing.

"We landed the men on that beach early one morning and they expected to wipe out a detachment of bothersome Japs," he said. "All of us approved of that operation because we were getting tired of snipers' bullets whizzing over our heads as we sat around during the evenings."

"Things didn't work out as planned that day. The Japs had machine gun positions on a high ridge back from the beach. They had their mortars set up behind the ridge and their best snipers in the trees. Just before supper, the marines sent out an S.O.S. with their walkie-talkie radio. We lost no time in getting under way in our 36-footers because when the marines send out an S.O.S. things are really tough."

As coxswain on a 36-foot personnel barge, Coppens had a two-man crew composed of engineer and deck hand. The latter is called a "bow hook." He rides in the bow and acts as gunner.

"The first landing craft that arrived at the beachhead strafed the ridge with machine gun fire," Coppens said. "One man who survived got the Navy Cross and the others the Congressional Medal of Honor. The rest of us closed in and worked fast because the Japs were peppering that beach with deadly mortar fire. Our boat had to pass through crossfire from two points before we could get near enough to the beach to get the marines."

Operating under continuous fire, the skippers of the taxi fleet made trip after trip to the beach until the last marine was removed. Some of the barges were unarmed. For this action, which is far from unique in the annals of landing barge crews, Coppens and the other skippers were cited for heroic action by Rear Admiral T. S. Wilkinson, deputy commander of the South Pacific Area. They were commended for "conduct in keeping with the highest traditions of the naval service of the United States."

Another example of this type of conduct occurred on a big transport commanded by a Coast Guard captain during the invasion of Sicily. A young deck officer spotted four attacking Messerschmitts during unloading operations and rushed up to the captain.

"Messerschmitts attacking, sir," he said. "Should we give the general alarm?"

General alarm means all battle stations must be manned.

"How many Messerschmitts are attacking?" asked the captain.

"Four," answered the young officer.

"Four!" snorted the captain. "Continue unloading operations as usual."

That's the spirit of the men in Uncle Sam's "taxi fleet."

Long-Arm "Lazyman" Drill Bores Hole in Lofty Plate

11840



Drawn by Coast Guardsmen
Bardonia, N.Y.

Shipyard worker steps on foot pedal which operates drill mounted on adjustable rod for overhead work

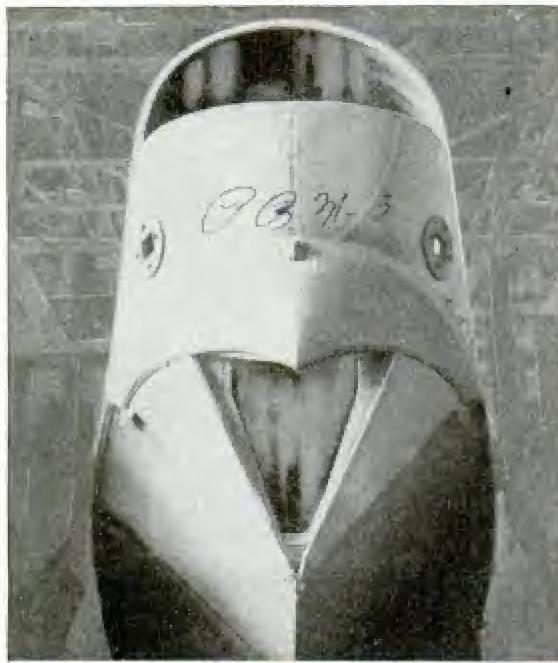
Ladders and complicated scaffolding are eliminated with an electric drill mounted on a long rod which is adjustable to various heights. The drill, called the "Lazyman" by workmen in the Todd Shipyards where it was invented, is operated by a foot pedal. It is used to drill holes in overhead plates, and its long reach saves many hours of production time. *Bardonia, N.Y., N.Y.*

Names and addresses of makers or sellers of commercial products described in this magazine are listed in the Where-to-Buy-It index. Write to them for additional information and be sure to Say You Saw It in Popular Mechanics.

Glenn L. Martin Co.
Baltimore 3, Md.

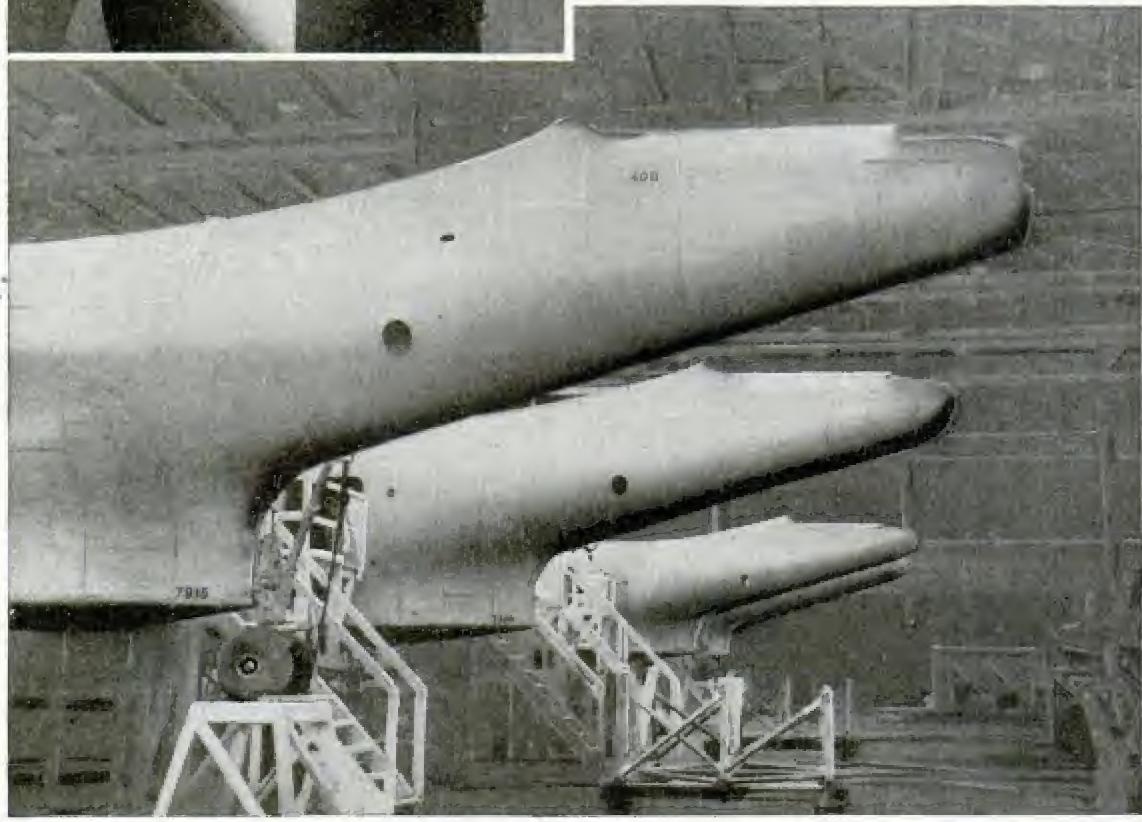
11771

Bombers Have Eagle Beak and Sharklike Tail



From ancient days warriors decorated their weapons to resemble rapacious animals and birds, but modern engineering often builds in an incidental likeness to a beast of prey. A head-on view of a Martin Mariner patrol bomber is a case in point. It requires no imagination to see in the warplane's prow the likeness of an eagle, beak open in a scream. The tapering tail of this big flying boat resembles a shark's nose, with a blackened port for an eye and a toothless mouth imaginable where the tail curves down to form the keel. The planes are in quantity production at the Glenn L. Martin plant in Baltimore.

Mechanical eagle with open beak is a Martin patrol bomber. Below, tail of flying boat resembles nose of shark—note eye



Hard Rubber Propellers With Metal Core Can Stand 60-Ton Stress

Propellers made of hard rubber into which bubbles of gas have been blown are lighter than those made of aluminum or magnesium alloy, but are able to stand a flight stress of 60 tons. The new propeller has a metal core, and over the hard sponge rubber is a shell of Du Pont's neoprene chemical rubber. The polished surface cuts

down wind resistance, serves as weather-proofing, and offers protection against cinders and gravel. Temperatures ranging from 70 degrees below zero Fahrenheit to 140 above have little effect on the propeller. Another advantage is in the new design of the propeller which is said to keep the motor cooler during takeoffs and in climbing.



The CRAFTSMAN

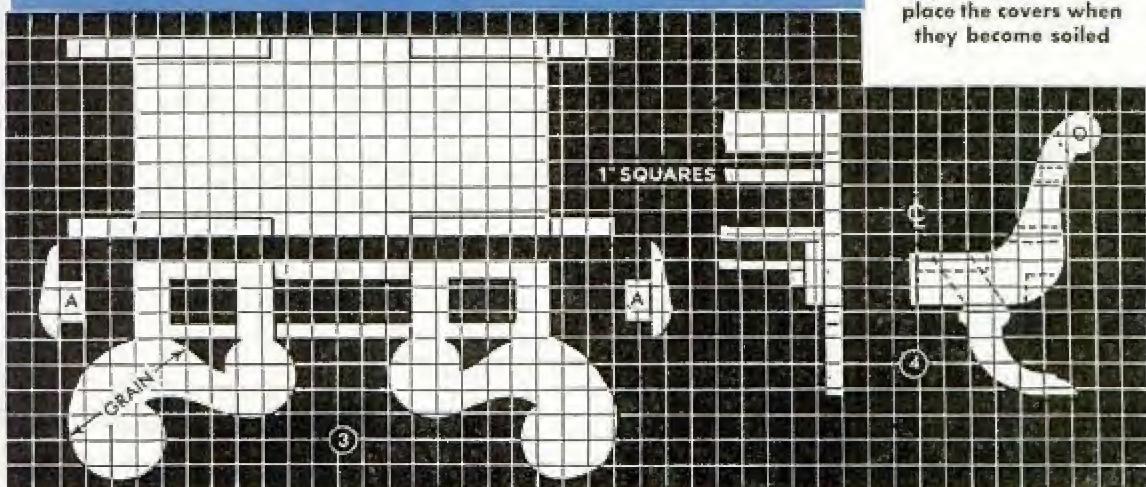
2 Victorian FOOTSTOOLS

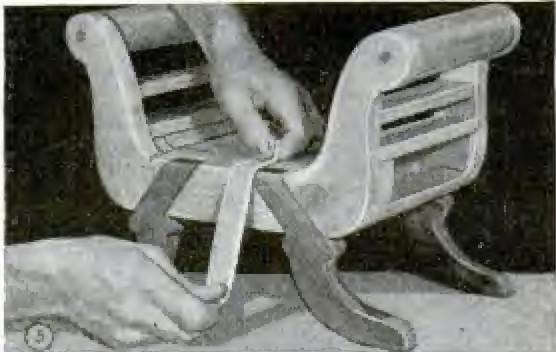
By Charles and Bertram Brownold

STURDY and easy to make, these two footstools are neat in appearance and have the advantage of being easy to recover when the cloth becomes soiled. The settee-type stool shown in Fig. 1 is unusually comfortable and restful to your feet, which are supported by the sides of the stool and thus prevented from turning outward with a resultant tiring twist of the leg muscles. Fig. 8 shows how the parts are assembled, and Fig. 4 shows a half pattern of one of the sides. Each of these consists of two curved



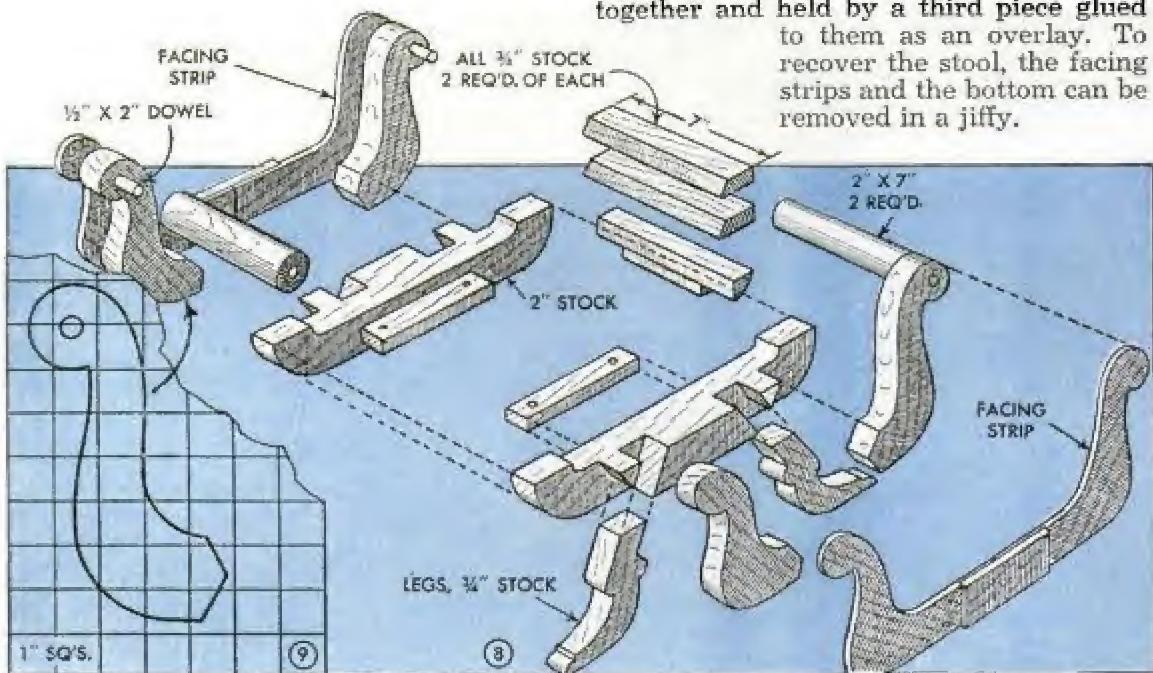
You can use light, gaily colored cloth covers on these footstools because it is a simple matter to replace the covers when they become soiled





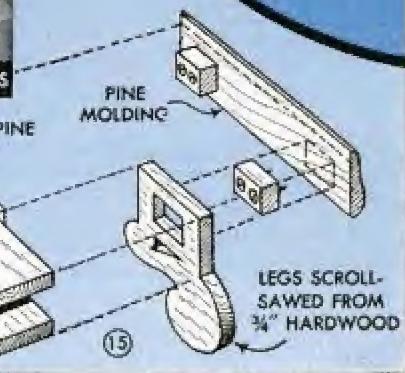
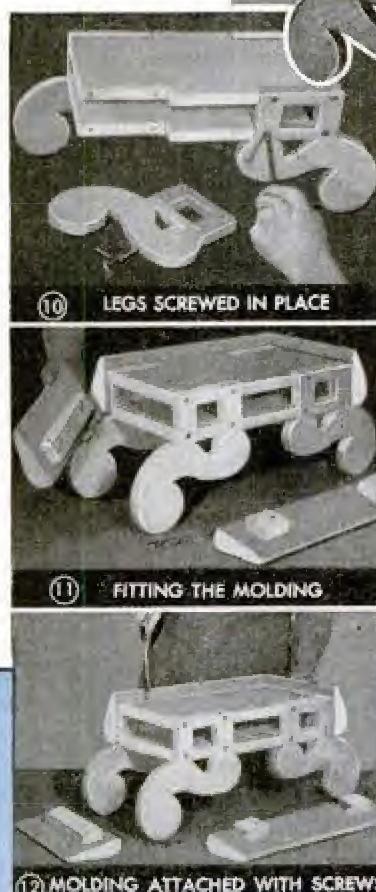
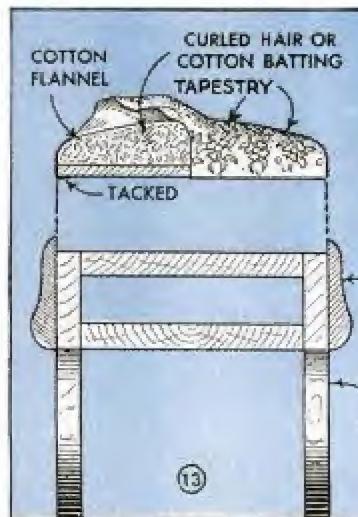
vertical pieces cut to the size and shape shown in Fig. 9, and jointed to a third piece of 2-in. stock, which is notched to take them as well as the legs. Size and shape of the legs can be determined from the half pattern in Fig. 4. After gluing up the two sides, they are assembled together by a 7-in. length of 2-in. round stock and three wood strips across each end. These are shaped as indicated in Fig. 9, and are positioned as shown in the end view of Fig. 4. A cushion or bottom can be made by upholstering a piece of $\frac{1}{4}$ -in. plywood or hard-pressed board to rest on cleats, which are screwed to the inner surfaces of the stool sides.

After the framework of the stool has been assembled, the edges are sanded as in Fig. 5 to provide neat rounded corners over which to stretch the cloth covering. Special care should be taken when sanding the edges of the strips across the ends to see that the graceful curve of the sides is maintained. The stool is covered first with cotton flannel, putting the nap side out, Fig. 6. The fleeciness of the flannel tends to soften the outlines of the frame. To get a smooth fit, remove the bottom and tack the flannel under the inner edges of the end strips. The bottom is covered separately and is screwed in place later. After the flannel has been tacked in place, tack on the outer covering. This cloth must be drawn over the edges of the framework and tacked to the sides. Facing strips of $\frac{1}{4}$ -in. wood to match the legs are used to conceal the tacks as in Fig. 7. Each strip is made of three pieces glued together, two of which are the size and shape of the side half patterns in Fig. 4. These are butted together and held by a third piece glued to them as an overlay. To recover the stool, the facing strips and the bottom can be removed in a jiffy.

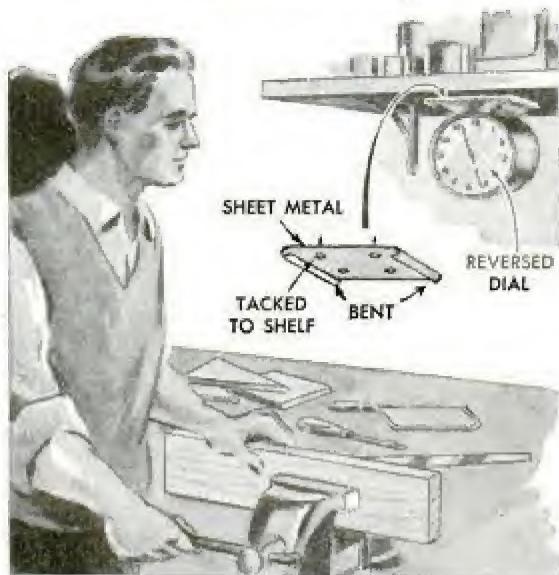


The stool shown in Fig. 2 has legs jigsawed from $\frac{3}{4}$ -in. stock to the shape shown in Fig. 3. After the legs have been cut and sanded, they are screwed to a top consisting of two boards cut out at the corners to take them flush as in Figs. 10 and 15. Molding 4 in. wide on its flat surface is fastened to the sides and ends of the stool, the molding first having been mitered at the ends. The molding can be purchased or it can be made from standard crown molding as shown in Fig. 14. It is attached by means of small blocks glued and screwed to it as indicated in Fig. 15, and as shown at A in Fig. 3. The blocks are slipped between the top boards and also between openings in the upper parts of the legs as in Fig. 11. Screws driven down through the upper board of the top and into the blocks as in Fig. 12, hold the molding in place.

The cushion rests in a recess formed by the upper edges of the molding projecting above the stool top, and is made by tacking cloth to a piece of plywood or hard-pressed board and stuffing cotton batting between them, Fig. 13. A better way to make the cushion so it will have a smooth and symmetrical contour is to first place the batting on the board and then lay the cloth over it and tack it to the underside of the board, pulling the cloth taut as you proceed. Then the cloth is covered with figured material of the desired color and pattern. The cushion is easy to remove for recovering.

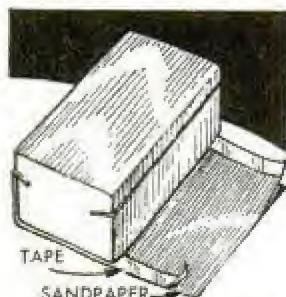


Shop Clock Hung Under Shelf Out of the Way



If your alarm clock in the workshop is in the way on a shelf, where it also may be pushed off and damaged, bend a strip of tin to engage the clock base and tack this under the shelf. As the clock will be supported in an inverted position you will have to loosen the face and give it a half turn for easy reading.

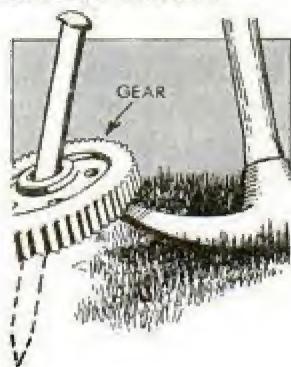
Tape Prevents Tearing Sandpaper



To avoid torn edges of sandpaper strips when they are used on a sanding block or in a special holder, one craftsman sticks a length of cellulose tape along each edge as shown. If cellulose tape is not available, decorators' tape will serve for the purpose.

Pick and Discarded Machine Gear Pull Steel Anchor Stakes

The difficulty of pulling a number of steel or wood stakes can be simplified by the use of a gear and pick as shown. The gear should be about 6 in. in diameter and should have a center hole somewhat larger than the diameter



of the stakes to be pulled. By dropping the gear down over the stake and prying it up at the outer edge with the point of the pick, considerable leverage can be exerted, and the tilted gear will grip the stake tightly enough to lift it.

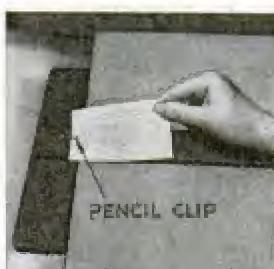
Leather Tacked to Wood Strip Makes Good Knife Sharpener

An inexpensive and handy knife sharpener can be made by tacking smooth strips of leather to opposite sides of a $\frac{3}{4}$ -in. wood strip $1\frac{1}{2}$ in. wide and about 10 in. long. Impregnate the leather on one side of the sharpener with coarse valve-grinding compound, and the other side with fine grinding compound. In use, give the knife a few strokes over the coarse side and finish on the fine side.

—Herbert Carr, Jr., Bangor, Me.



Artist's Data Card on T-Square Convenient for Reference



Artists and draftsmen whose work requires frequent reference to a data card will find that such a card or slip of paper may be held conveniently on the T-square by means of a pencil clip. The band portion of the clip is opened and the resulting prongs are tacked to the square in the position indicated.

Wire Serves as Pouring Guide

When you have to pour liquid from a small bottle into a container having a very small opening, such as a cigar lighter, try the following trick: Bend a wire as indicated, insert it into the bottle and use this as a guide for the liquid to enter the container. Pouring cannot be rapid, but if the thumb is held over the bottle mouth and the liquid released very slowly, it will follow the wire.

—John R. Clawson, Fort Hamilton, N. Y.

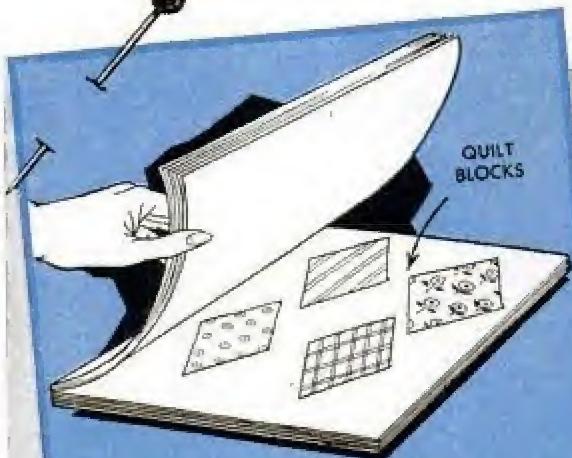


100 W. P.

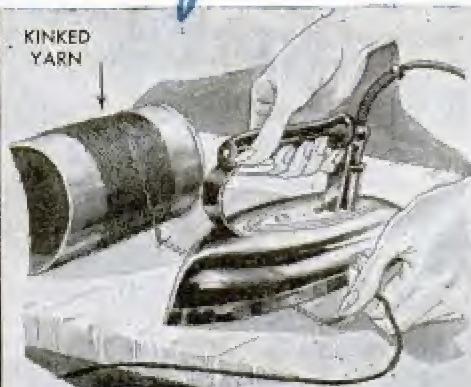


Having a capacity of $2\frac{1}{2}$ cu. ft., this garden barrow folds into a space 4 by 28 in., and by removing the wheels for winter storage, it takes even less space. Its small size when folded makes the barrow easy to take in a car, and its light weight enables anyone to handle it with ease. Being almost 2 in. thick, the wheels will not sink into soft ground. A leg hinged at the back supports the barrow in a horizontal position when the handles are released, and is held by a turnbutton when not in use.

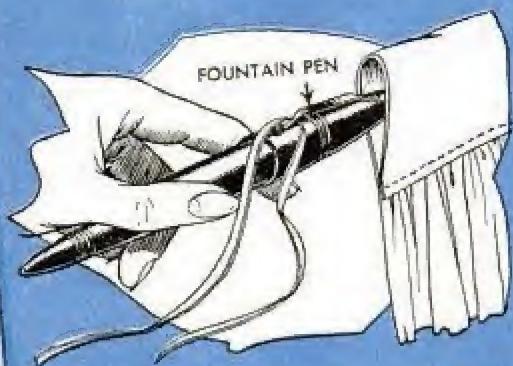
Solving HOME



To keep quarter sections of quilt blocks flat and sorted in harmonious color combinations, place them between the pages of a magazine



An easy way to steam the kinks from yarn that is to be re-used, is to wind it on a can, dampen and then iron as it is drawn through holes in a pressing cloth



A ribbon or draw string can be run through a large hem quickly by using a fountain pen as a "needle," the string being held by the clip



You can thread a needle in less time if each spool has a bit of beeswax on it through which you can draw the thread to stiffen the end for insertion in the eye

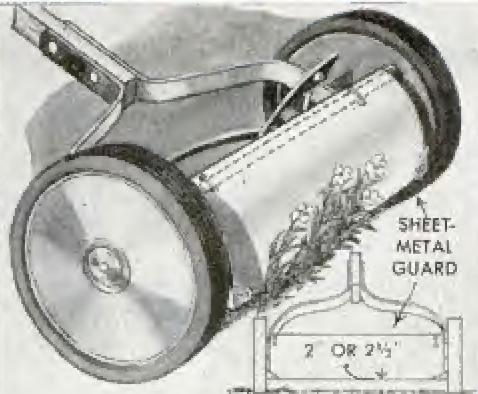


Small throw rugs will "stay put" on highly waxed floors if they are sewed to the back of oilcloth, glossy side next to the floor



Tabs of tape holding safety pins at each end of a wire clothes hanger will keep a skirt stretched without wrinkling it in a wardrobe case

PROBLEMS



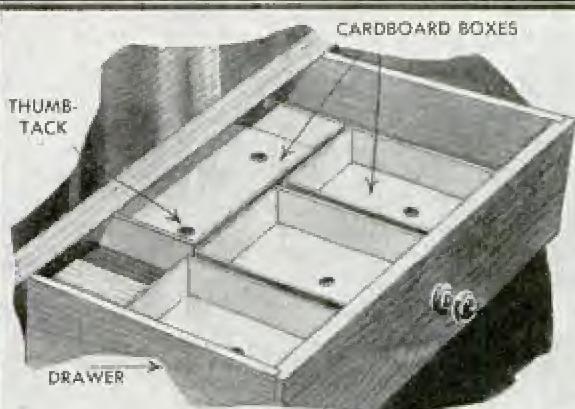
This sheet-metal guard permits trimming the grass close to flowers and shrubs, which are pushed back to protect them.



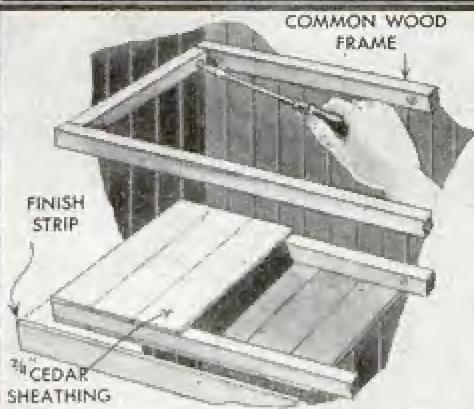
A sturdy cardboard box with top removed and edges strengthened by a frame provides a lightweight box for toys. A small box on the side holds books.



A U-shaped pipe placed over a steel rod and through a hole in the garbage-can lid will hold the can so dogs won't tip it.



Drawers in which small items of different sizes are kept will stay more orderly if suitable cardboard boxes are fastened to the bottom with thumbtacks.

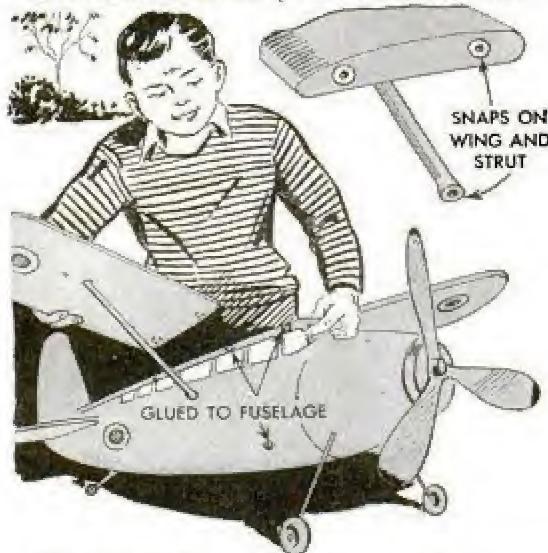


If 1-in. cedar boards are not available for closet shelves, make a frame of pine and cover this with $\frac{3}{8}$ -in. cedar sheathing.



Spraying dry clothes on the line with a fine mist from a garden hose is a quick way to dampen them.

Snap-On Wings for Model Planes Are Less Likely to Be Broken

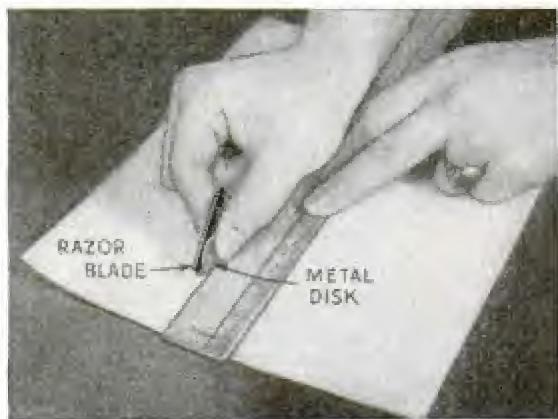


Model airplane wings are much less apt to be smashed when the plane strikes an object or makes a poor landing if they are attached to the fuselage with ordinary dress snaps, which will allow the wings to pull away from the fuselage without damage. One half of each snap should be glued to the wing and strut ends, and the matching halves glued to the correct locations on the fuselage. Allow the first coating of glue to set until thoroughly dry; then reinforce with more glue. The fuselage should be made somewhat stronger to take the added strain, but the extra weight will not be enough to interfere with flight. For carrying or for storage the easily removable wings also prove handy.

—Lynn Christensen, Long Beach, Calif.

Small Coin Protects Edge of Ruler When Cutting Paper With Razor

To protect the edge of a wooden ruler from being slivered with a razor blade when cutting paper or cardboard, hold a small coin or similar metal disk between



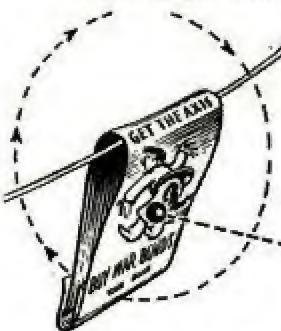
the blade and the ruler edge. This can be done by holding the coin and blade with the fingertips as shown.

Empty Copper Shell Removes Rust Without Scratching Gun

When a gun becomes rust spotted, don't use a knife to scrape away the spots. Flatten an empty copper cartridge and use it as a scraper. The soft copper will not scratch the steel, but will remove the rust.



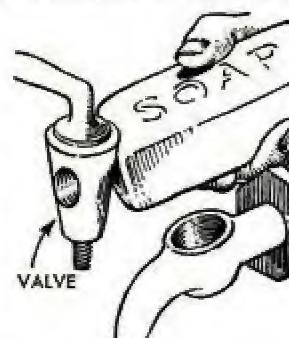
Empty Match Book on a String Provides Air-Rifle Target



A target for air-rifle practice can be made by clipping an empty match book to a wire stretched between two supports. As these books are usually waxed, they will deflect the shot and spin if hit.

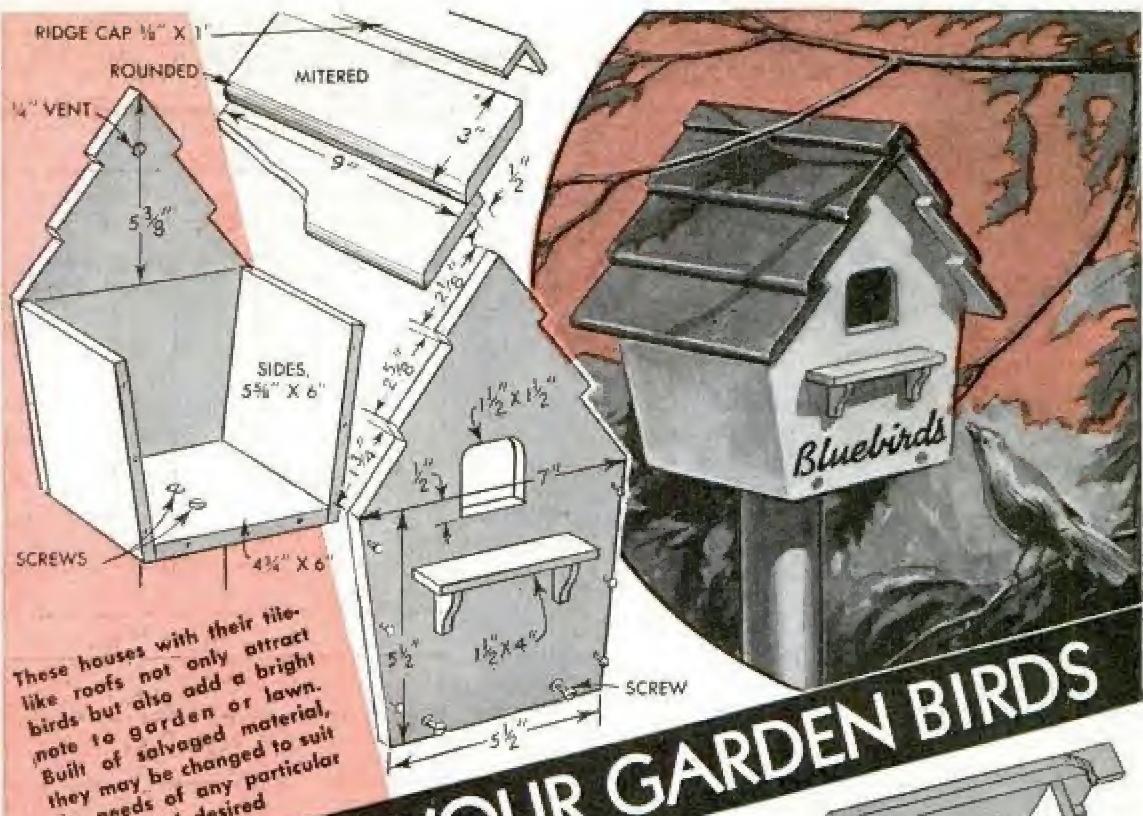
Soap Seals Leaky Gasoline Faucet

If a leaky faucet on a gasoline barrel is of the type shown, you can seal it and also lubricate the valve for easy turning by applying a coating of soap to the valve. Yellow laundry soap is best if available.

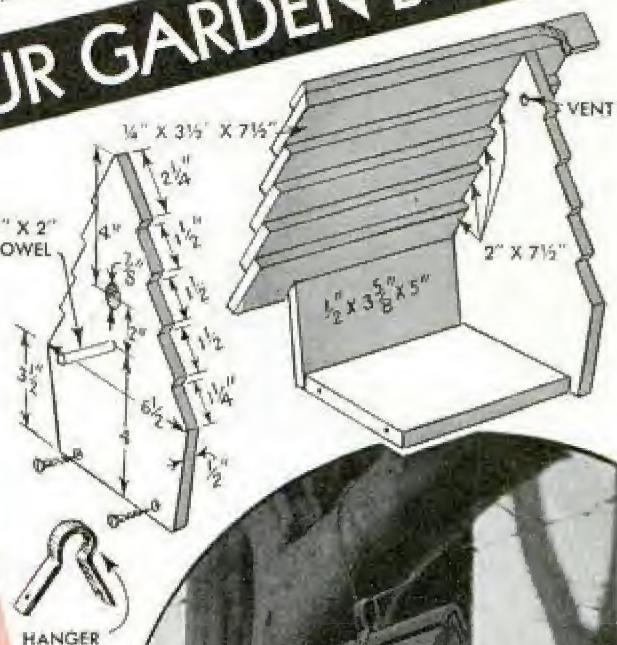
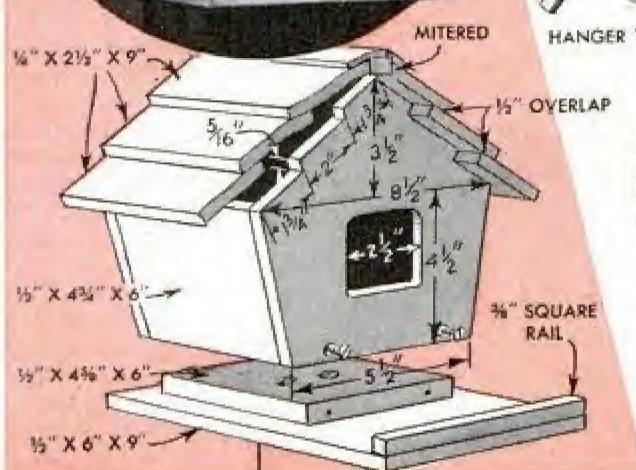


Coupling Trailer More Easily In Close Quarters

In situations where a trailer cannot be reached conveniently for coupling, attach a towing chain or rope to the trailer coupling. After carefully pulling the trailer a few yards, it should be aligned with the tow car, which can be backed up and coupled in the regular manner. On a slope, of course, chock blocks and the trailer's brakes should be used to prevent accidents.



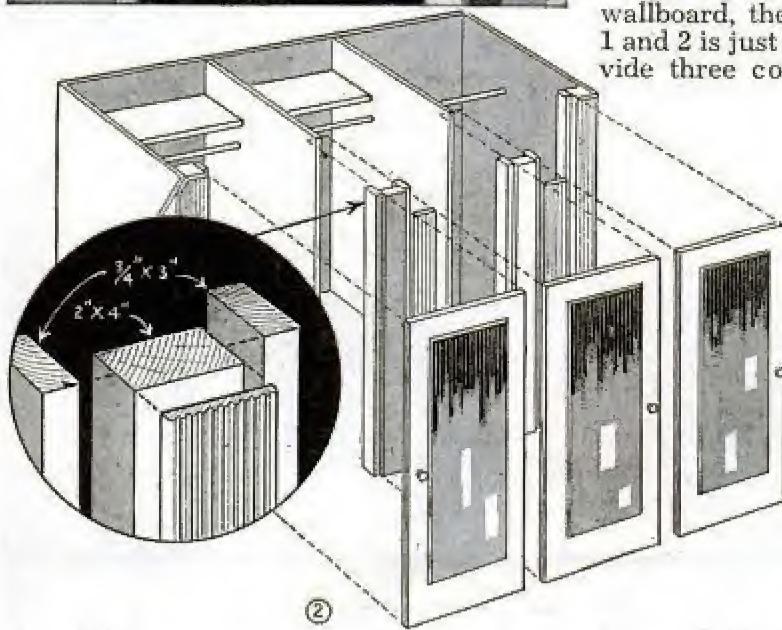
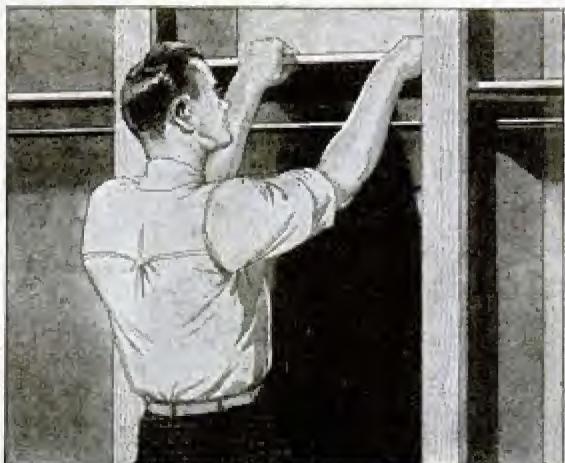
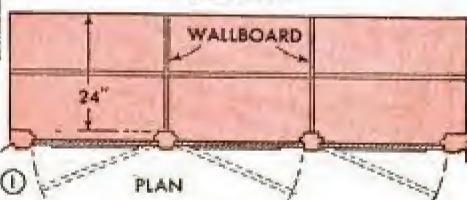
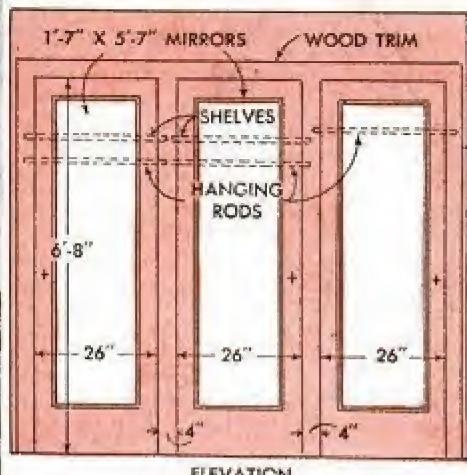
HOUSING YOUR GARDEN BIRDS



Built-in BEDROOM



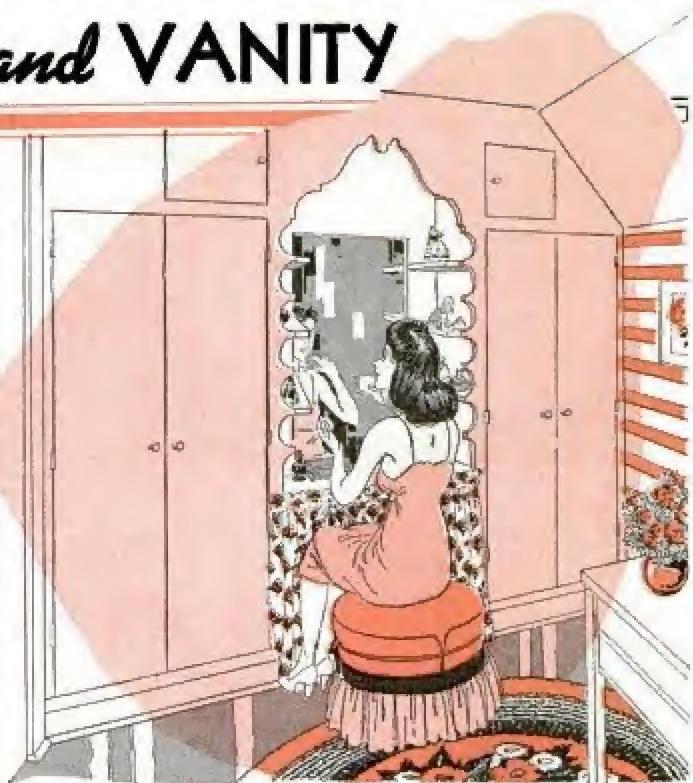
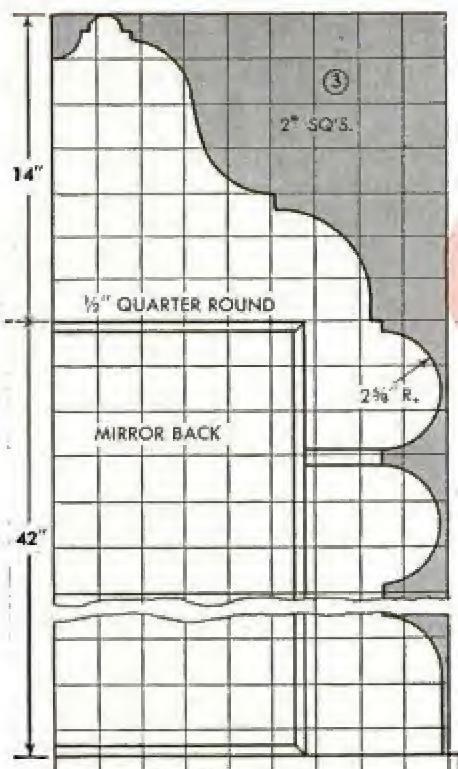
Wardrobe



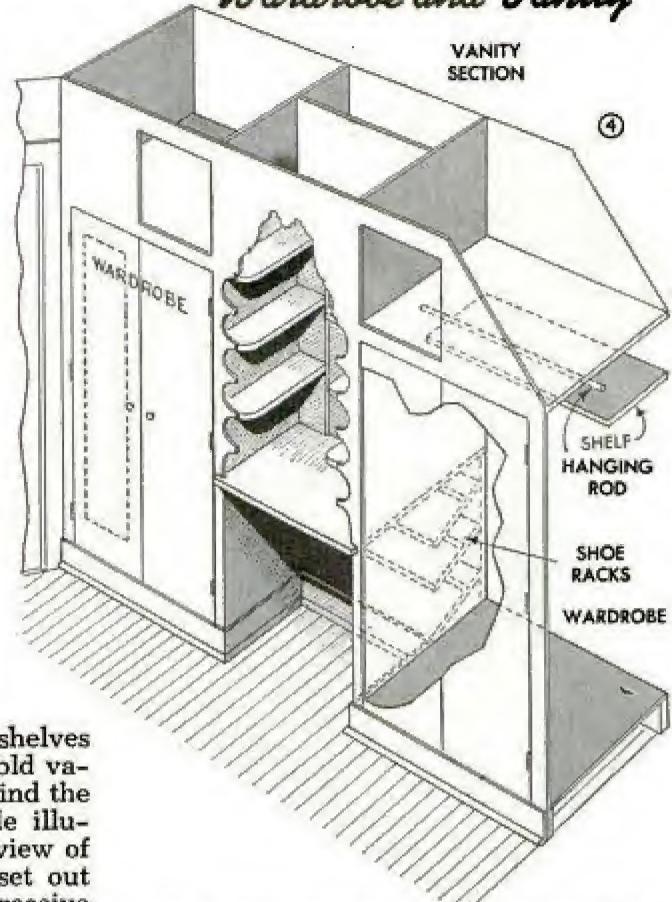
MANY of the problems of furnishing an attic bedroom and providing adequate closet space are solved by building in a wardrobe like the one shown above, or a vanity with wardrobe sections at the sides like the one shown on the opposite page. Used in the U. S. Gypsum Company's Remodel Research house, the wardrobe and vanity are easy to build, and they dress up a room, especially if it is long and narrow.

Faced with plaster board or other hard wallboard, the wardrobe detailed in Figs. 1 and 2 is just a simple framing job to provide three compartments or closets of equal size, each being fitted with a mirrored door. Although plain flush or paneled doors can be used, the added attractiveness of the mirrored doors makes their extra cost well worthwhile. Since the width and height of your room will govern the size of the wardrobe, the dimensions given in Fig. 1 are only approximations and are intended as a guide in proportioning the one you build. As large panels of wallboard are used for the facing, back and partitions, the framework

WARDROBE and VANITY



Wardrobe and Vanity



can be scantier than when regular wood boards are used. The circular detail of Fig. 2 shows how the doors are framed. The beaded trim is standard stock that can be obtained at most lumber yards. The shelves shown near the tops of the compartments are supported on cleats, and the hanging rods for garments can be supported by suitable brackets.

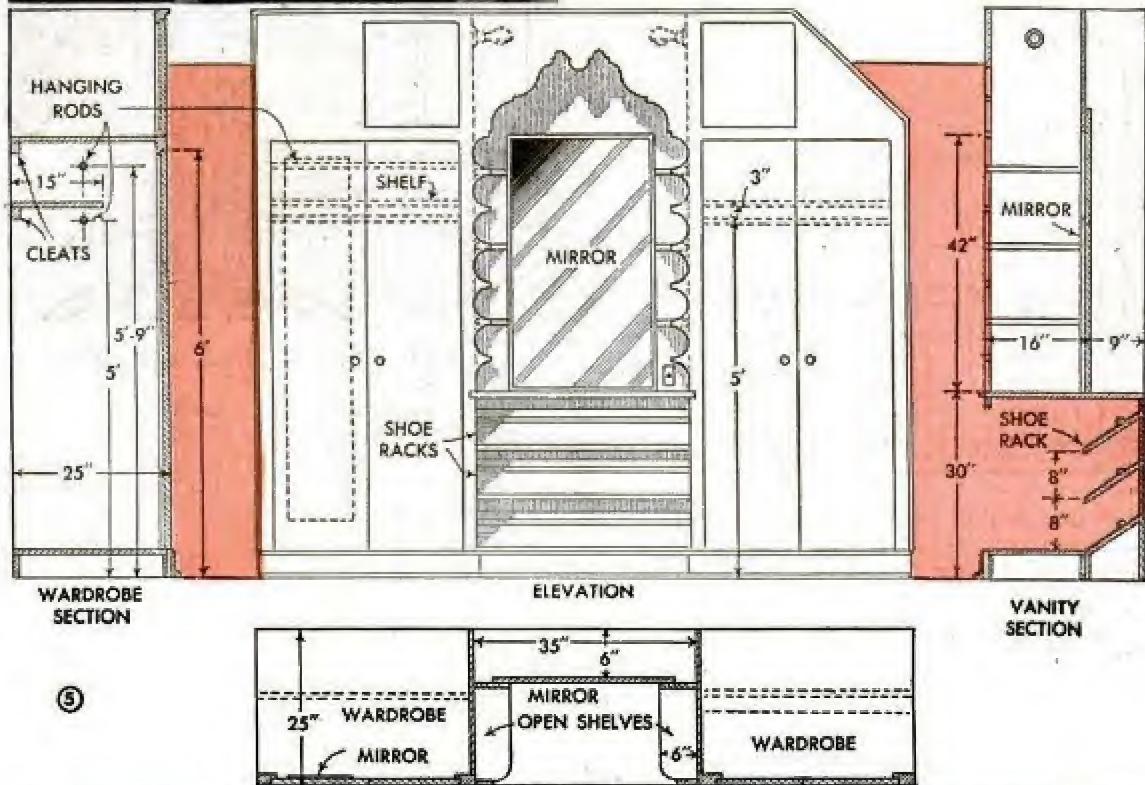
The vanity and wardrobe shown in Fig. 4 is ideal for a lady's room. It has a wardrobe at each side and storage compartments at the top. Overall general dimensions are given in Fig. 5. The size and shape of the scrollwork around the vanity portion is shown by the half pattern in Fig. 3. The skirted front of the lower section of the vanity hides handy shoe racks, and narrow shelves along the sides of the upper part hold various toilet articles. Two lights behind the scrolled front near the top provide illumination. As indicated in the top view of Fig. 5, the back of the vanity is set out 6 in. from the wall and is cut out to receive a large mirror, which is slightly larger than the opening so that it rests against the back where it can be held by a rabbeted frame

screwed to the back. The screws should be driven in from the front through the back and into the frame, countersinking

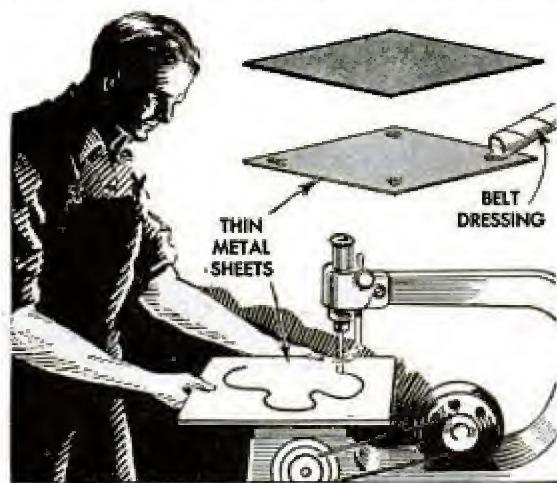


and putting the heads. Do this carefully so that the heads will not be visible after the back has been painted.

Construction and framing of the vanity are somewhat similar to that of the wardrobe except that the vanity has flush, double-hung doors for each wardrobe section and raised floors. Making the raised floors is just a matter of laying them over box frames that will fit snugly inside the wardrobe sections and then letting the ends and facing of the vanity extend down over them. Mitered baseboards and quarter rounds provide a finished appearance where the vanity contacts the room floor.



Belt Dressing Holds Metal Sheets Together for Duplicate Sawing



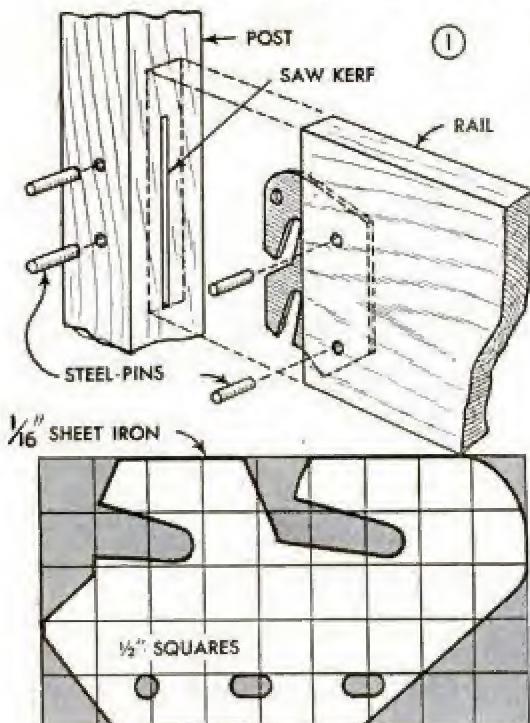
If you have several sheets of thin metal to cut in duplicate pattern, you can hold them securely together by placing dots of stick belt dressing at the corners and then pressing the sheets firmly together. Very little dressing is required and can be placed where the saw blade will not cut through it.

Milk Can Used as Food Chopper

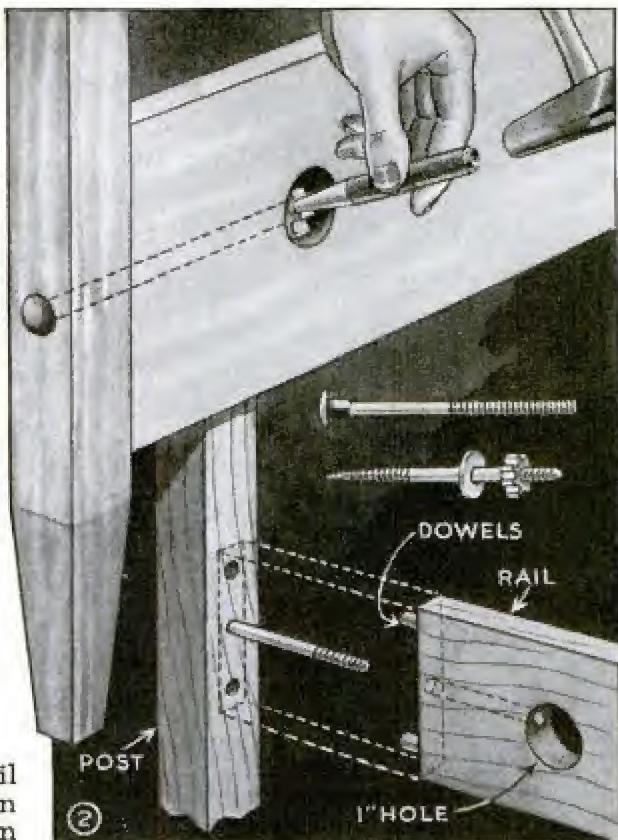
An evaporated milk can with one end entirely removed makes a good vegetable chopper. If the edge is ragged, hold the can over a flame until heat melts the solder and the rim falls away. This simple chopper does an excellent job, especially when used in wooden bowls.

—Mrs. S. Everingham, Latham, N. Y.

You Can Make Your Own Bedrail Fasteners



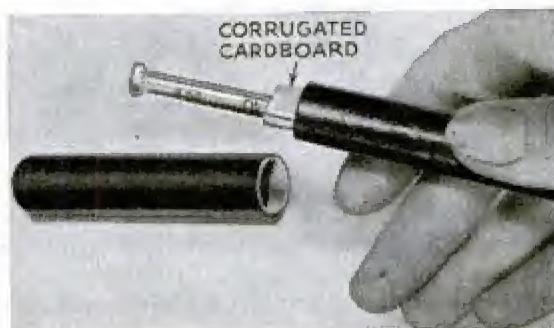
If you are unable to purchase bedrail fasteners when making a bed, they can be shaped easily from scrap metal as in Fig. 1. Cut or file four pieces as shown in the squared detail. Much of the work can be done by drilling a series of holes and then filing the pieces to the finished size. Cut grooves in the ends of the bedrails deep enough to allow the fasteners to be supported at least one half of their length. It is best not to run the saw kerfs through to the top of the rail. Limit the cut to the end and bottom edges only. Drill holes for pins in both the rail and post, and drive in the pins. You can hide them by drilling the holes from the inside surface of the rail and post, stopping them before the drill breaks through the outside surface. Another way of fastening the rails to the posts is shown in Fig. 2. Prepare the rails as though you planned to fasten them permanently to the posts with $\frac{1}{2}$ -in. dowels. Glue the dowels in the rail ends, letting them project $\frac{3}{4}$ in. Then drill a pilot hole for a handrail bolt in the post and another hole in the end of the rail to a depth of $2\frac{1}{2}$ or 3 in. to take the bolt, which is fitted with a nut that is notched around the edges. Now, bore a hole running through the thickness of the rail to accommodate the nut. Place the rail in position and drive the nut on the threaded end of the bolt. You can do this with a punch and hammer as shown in the upper right-hand detail. If you cannot obtain a handrail bolt, a carriage bolt can be substituted. Only the rounded head will show, and if this is objectionable you can counterbore the hole to sink the head and conceal it with a plug.



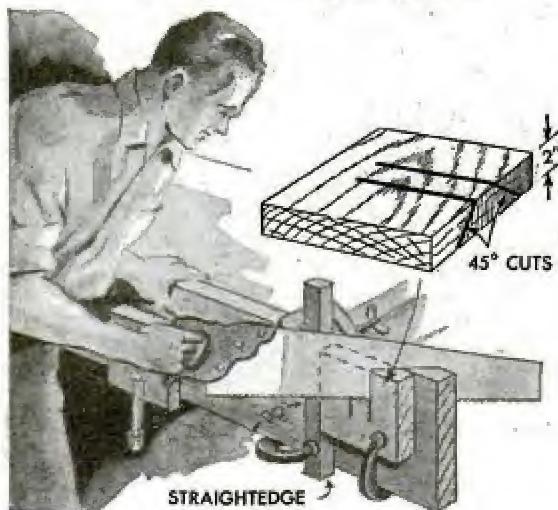
riage bolt can be substituted. Only the rounded head will show, and if this is objectionable you can counterbore the hole to sink the head and conceal it with a plug.

Cardboard Protects Thermometer Inside Its Container

The safest place to keep a glass thermometer is in its original container. But to unwrap the thermometer from the tissue paper every time it is needed is annoying and a waste of time. A simple way to avoid this is to insert a strip of corrugated cardboard into the container beside the thermometer. This serves the same purpose as the tissue paper and permits the thermometer to be withdrawn and inserted easily.

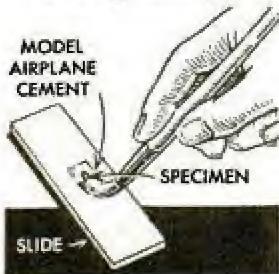


It Is Easy to Miter Wide Work With This Simple Block



Work too wide to cut in a miter box can be mitered to the usual angles by using this block. To make it, select a straight-grained section from a 2 by 10-in. board. Lay out the cuts desired and carefully saw the slots, making them 8 in. deep. Slots of 30, 45 and 90 degrees are the most common. To use the block, clamp a wood straightedge across the stock to be mitered with C-clamps. Apply them loosely at first and hold the block against the straightedge, moving the whole assembly laterally until the miter slot is in the right position. Be sure the straightedge is square with the work. Then tighten the clamps and saw the miter, making the first cut to the bottom of the slot. Then, hold the saw firmly in the slot and move the block downward for the next part of the cut, repeating this procedure until the stock has been severed.

Temporary Microscope Slides



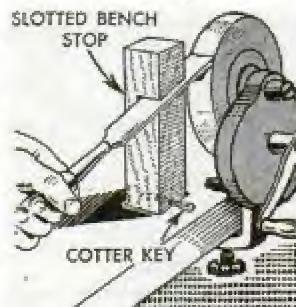
If you want to make up a few microscope slides for temporary use, you can do the job very easily by attaching the specimens to the glass with model-airplane cement, which is available

at any hobby shop. First, clean a blank slide in warm water, and then wash the specimen in alcohol and rinse it in cool water. Place the specimen on the slide and absorb all excess liquid with a dry cloth. Now, with a small camel's-hair brush, apply a thin coat of cement to the specimen, letting the cement extend down onto the slide. After the cement has dried, the spec-

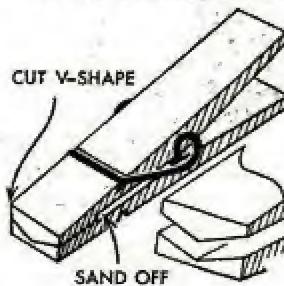
imen will adhere to the slide and will be protected from dust and moisture. The specimen can be removed by washing the slide in warm water.

Chisels Held at Grinding Angle In Slotted Bench Stop

Amateur woodworkers who have difficulty sharpening their chisels correctly can avoid this trouble by using a bench stop to support the chisel at the correct angle against the grinding wheel. The chisel is held in a slot in the stop, which is kept at the desired height above the bench by means of a nail or cotter key as indicated. When not in use, the stop is removed or pushed down flush with the bench top.



Spring Clothespin Used as Clamp When Assembling Model Work

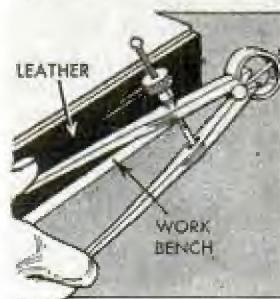


I have found that by slightly altering the jaws of a spring-type clothespin it is very handy for holding up dihedral joints on a model glider or airplane. The inner surfaces of the jaws of the pin are sanded to a V-shape, after which the remaining inner surfaces of the jaws are sanded down back to the spring to provide a throat.

—Alfred Languirand, New Bedford, Mass.

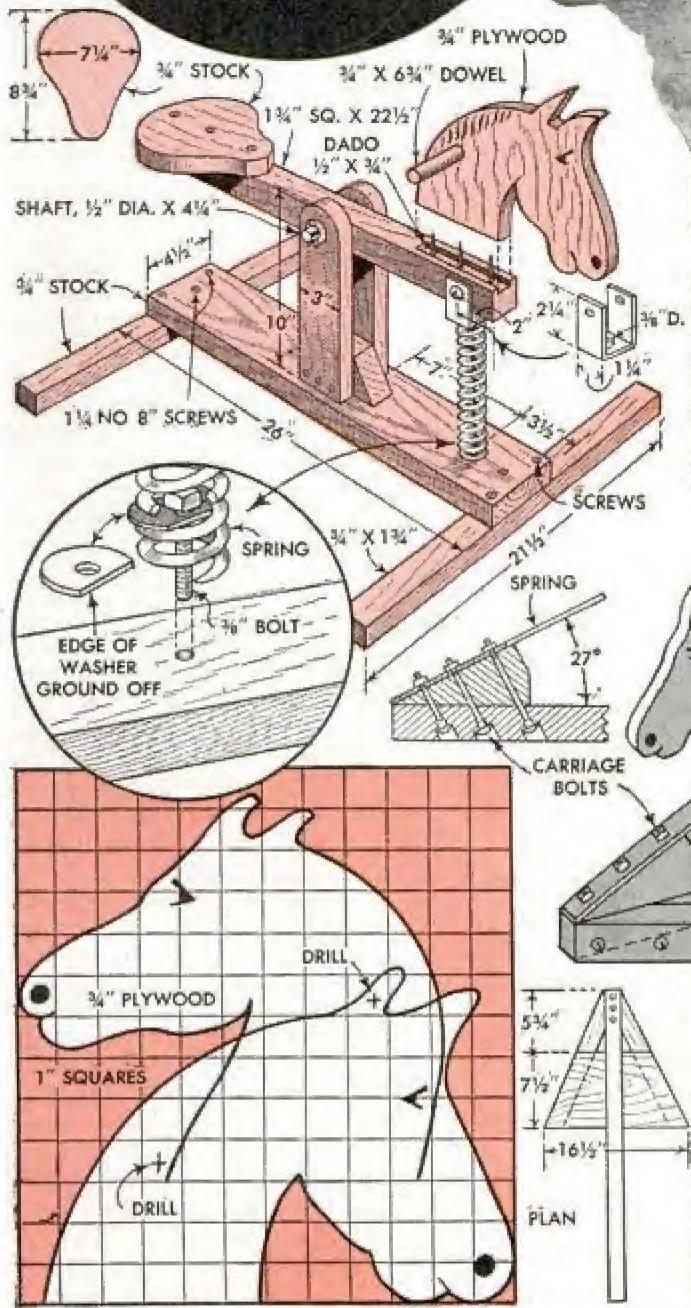
Leather Strip Opens Dividers

To save time when laying out work on a bench, one artist glued a strip of soft leather to the edge of the bench where it would be convenient to his right hand. Now, whenever it is necessary to adjust a pair of dividers, he merely holds them in his hand and runs the knurled nut across the leather strip to rotate it. Of course, the dividers should be held in the closed position while rotating the nut.



RIDE 'EM Cowboy!

*Children Like these
Play Horses*



Coil-Spring Model

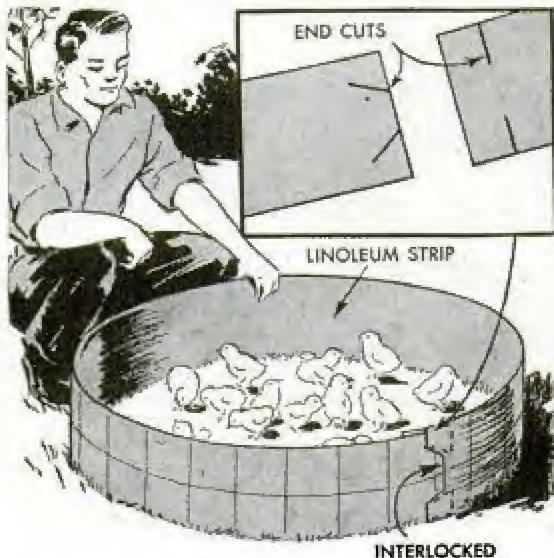
The model detailed at the left has the riding arm pivoted on a shaft at the center, the action being provided by a coil spring. A spring about 1 in. in diameter and having twenty coils of 1/16-in. wire will support the average child. The spring should allow movement of at least 4 in. Any wrecking yard will yield a variety of suitable springs. If one strong enough cannot be found, try using two weaker ones side by side.



Spring-Leaf Model

For the spring-leaf model, an automobile bumper spring that is not too stiff is better than an auto-spring leaf. Spring steel is difficult to drill so it is advisable to have this work done with a cutting torch. The horse's head is held in place by a metal clip and is adjustable along the spring. A wooden seat can be used instead of a tricycle seat.

Strips of Linoleum Replace Wire For Portable Chick Pens



If you are unable to obtain wire to use as portable pens for your baby chicks, fair substitutes can be made from strips of linoleum. The ends of each strip are notched as shown, so that they can be locked together, making a circular pen that can be moved easily. When not in use, the linoleum can be opened flat for storage.

"Breaking In" New Pen Point



Oil or other rust inhibitor used on new pen points can be removed so that ink will flow readily by holding the pen in the flame of a match, taking care not to heat the metal enough to remove

the temper. In most cases, it is impossible to remove the inhibitor by wiping with a cloth, as some of the liquid will remain between the pen nibs.

Disturbing of New Grafts by Birds Prevented With Long Perches

After grafting, I have often lost valuable cions because birds would alight on them and displace them. Noticing that the birds always alighted on the highest cion, I prevented the

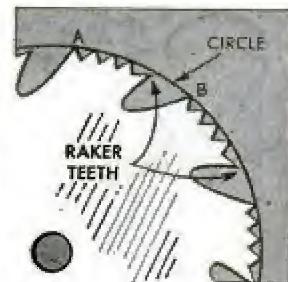


trouble by providing perches which extended a few inches above the cions. The perches are merely small sticks taped or tied to the parent branch. One perch will protect two or more cions if the latter are on the same branch. When the grafts become strong enough to support a bird, the perches should be removed.

—Chas. S. Marshall, Baptists, N. J.

Pointers on Filing Circular Saw

When sharpening saw blades of a bench-type circular saw used in home workshops, the height of the raker teeth in relation to the pointed teeth often is overlooked. The ends of the raker teeth should be about $\frac{1}{64}$ in. lower than the other teeth. In jointing and filing a saw blade the diameter is always being diminished so that a set gauge would not always be a correct guide. A simple method of checking the teeth is to draw on a board a circle of the same diameter as the saw blade. Then, after filing, lay the blade on this circle having two teeth as at A and B just touching the circle. The raker teeth should miss the circle about $\frac{1}{64}$ in. If they do not, pick up the blade and give the raker teeth a stroke with the file and repeat until correct.—A. J. Harsted, Helena, Mont.



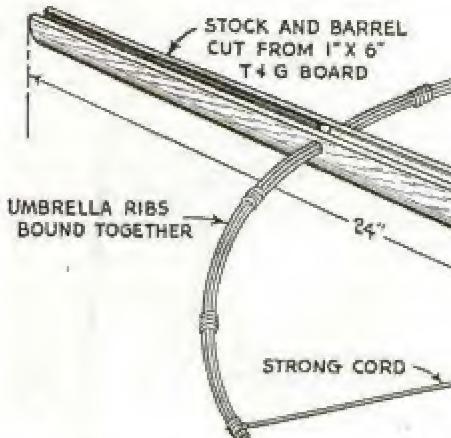
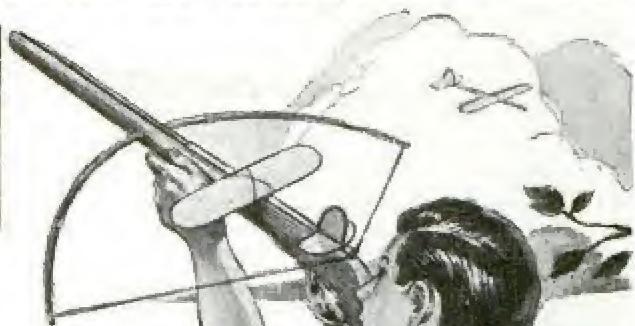
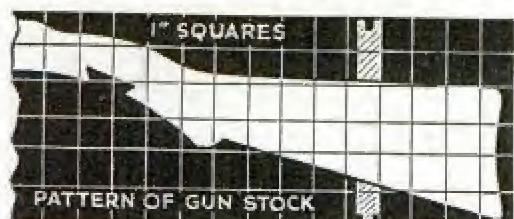
Stencil "Taped" in Place



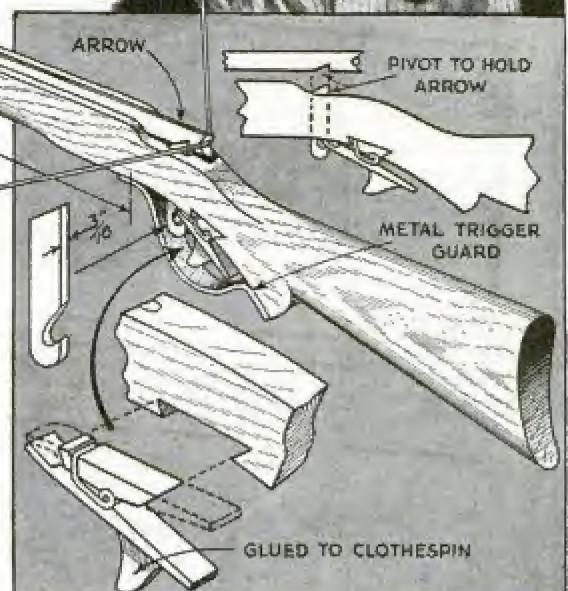
Inexperienced users of decorative stencils will find that this idea enables them to work faster and do a better job, because tape helps hold the stencil in place. Just cut a $\frac{3}{4}$ -in. hole at each corner of the stencil and over these place pieces of adhesive or masking tape, preferably the latter. In use, place the stencil in the desired position and with the finger tip, press the tape through the opening in contact with the surface to be stenciled. In this way, the tape helps prevent the stencil from slipping while applying the color.

►A small, inexpensive mirror hung on the wall opposite the medicine cabinet will enable you to see the back of your head. Moving the door of the cabinet in or out will bring the image into the right place.

Crossbow Shoots Arrows or Launches Planes



Ideal for shooting arrows or launching model airplanes, this crossbow has an easy-to-make trigger assembly and utilizes three or four umbrella ribs lashed together as a bow. The barrel and stock are shaped from a piece of tongue-and-grooved board, and the trigger is assembled from a thin wooden piece and a spring-type clothespin. Sand the groove in the barrel smooth and wax it and the hardwood arrows so they will slide easily. When using the crossbow to launch planes, the fuselages should be of a shape to slide freely in the groove, and the tail ends notched the same as the arrows.



Smoker's Accessories Kept Dry in Jar Under Deck of Boat



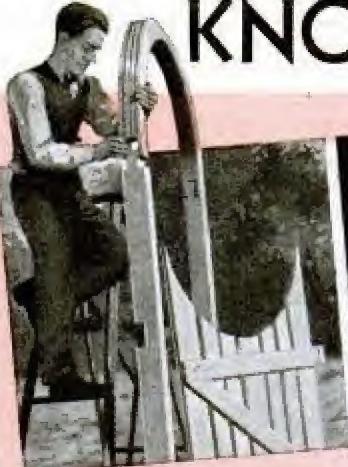
On fishing trips, a good way to carry your pipe, tobacco, cigarettes and matches is to put them in an ordinary fruit jar which is suspended under the deck or seat of the boat. To do this the lid of the jar is nailed or screwed to the underside of a seat so that the jar can be removed by unscrewing it from the lid. Using a rubber jar ring prevents the tobacco from drying out.

Rosin Keeps Shaver Screw Tight

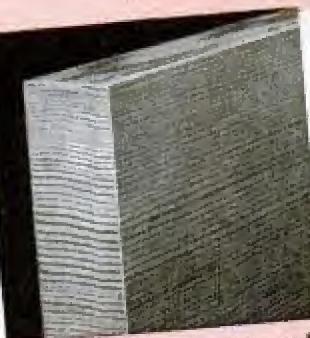
I had a great deal of difficulty with the thumb screw that holds the head of my electric shaver in position, as it always became loose due to the vibration of the motor, no matter how tightly it was screwed. So, I took the screw out, sprinkled it with powdered rosin and put it back, which cured the trouble completely.

—Fred Cornelius, El Paso, Tex.

KNOW WOOD for BETTER



1—This arch will last. It is:
 (a) Hard Maple (c) Redwood
 (b) White Pine (d) Red Gum



2-The end grain shows this wood has been:
 (a) Slash-sawed (c) Flat-cut
 (b) Quarter-sawed (d) Plain-sawed



3—Steam bending is easy with:
 (a) Mahogany (c) Birch
 (b) White Pine (d) White Oak



4—Careful! This wood splits:
 (a) Beech (c) Sycamore
 (b) Ash (d) Poplar



5—Excellent for white inlays:
 (a) White Pine (c) Holly
 (b) Poplar (d) Prima Vera



6—This mallet head is one of the hardest woods. It is:
 (a) Harewood (c) Cocobolo
 (b) Chestnut (d) Amaranth



(a)-11
 (g)-01
 (a)-01
 (a)-01
 (c)-
 (a)-8
 (a)-6
 (a)-5
 (a)-4
 (a)-3
 (a)-2
 (a)-1
 (a)-0
 ANSWERS

7—This shutter will be very durable against all kinds of weather:
 (a) Hickory (c) Cypress
 (b) Spruce (d) Basswood



8—It's easy to see this is:
 (a) Bird's-eye Maple (c) Flake Figure
 (b) Sycamore Burl (d) Feather Crotch



9—Excellent for boat planking:
 (a) Mahogany (c) Fir
 (b) Ash (d) Red Oak



10—Best wood for points:
 (a) Orientalwood (c) Maple
 (b) White Pine (d) Locewood



11—This is most likely to happen when wood is:
 (a) Green (c) Heartwood
 (b) Flat-cut (d) Edge-grain

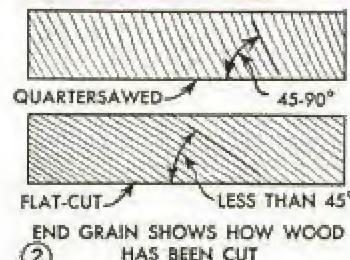
**Do You
Know Your
WOODS ?**

TRY THIS SIMPLE
CRAFT QUIZ

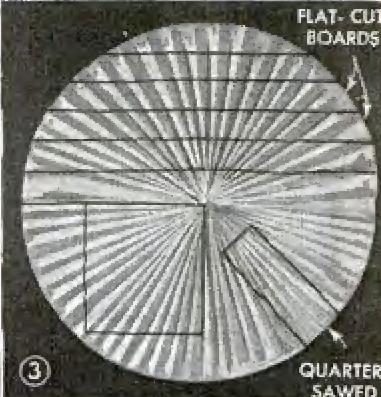
CRAFTING

KNOWING wood not only adds to the enjoyment of crafting but also helps in making any project a success. Naturally, the crafter is chiefly interested in how the wood will look when finished, but other important features should not be neglected.

Stability: "Will it stay put?" is an important consideration in all forms of woodcrafting. All woods shrink in seasoning, which causes distortion or warp, the four principal types being shown in Fig. 4. Some woods warp more than others, as indicated in Table No. 1, and can be made more stable by proper use. The common method of testing a board for warp is shown in Fig. 1. Sticks placed at either end of the board reveal cup and also show any twist or wind. The top edge of one stick should be light and the other dark to provide maximum vision. Just what makes a board warp is often illustrated by means of a fan made from a strip of thin paper about 6 in. wide by 2 ft. long. Brush marks are drawn across the fan to represent boards sawed from a tree, Fig. 3. Shrinkage in wood always occurs along the annual rings, so that if the fan is cut on either side, it will immediately shrink just like a split log would do. What happens to the original straight boards is shown by the

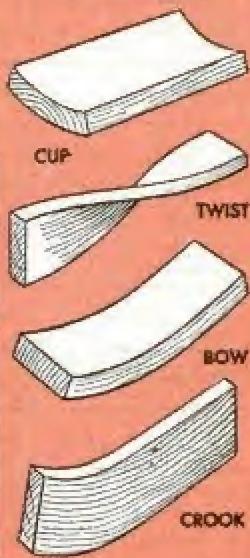


END GRAIN SHOWS HOW WOOD HAS BEEN CUT
②



③

SIGHTING IS A COMMON METHOD OF CHECKING TO DETERMINE AMOUNT OF TWIST OR WIND IN A BOARD. DIAGRAMS BELOW SHOW THE FOUR TYPES OF WARP



TYPES OF WARP ④



PAPER FAN ILLUSTRATES FLAT AND QUARTERSAWED LUMBER AND SHOWS EFFECT OF SHRINKAGE
⑤

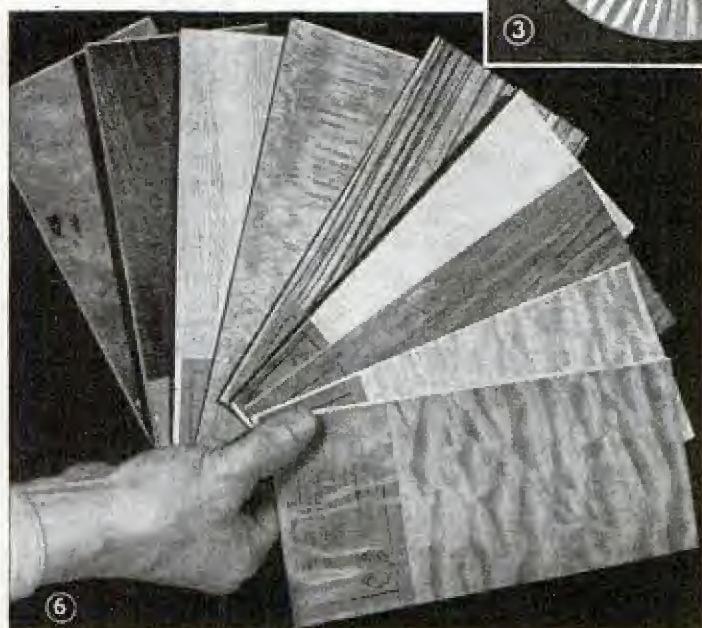


Table No. 1 WORKING PROPERTIES OF COMMON WOODS

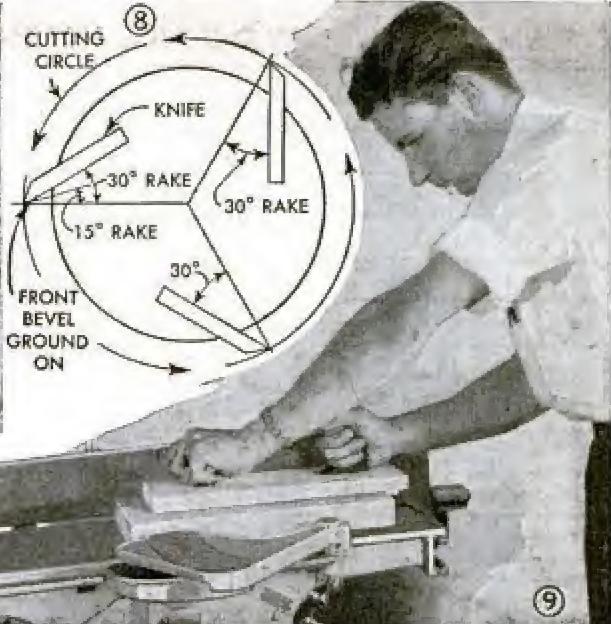
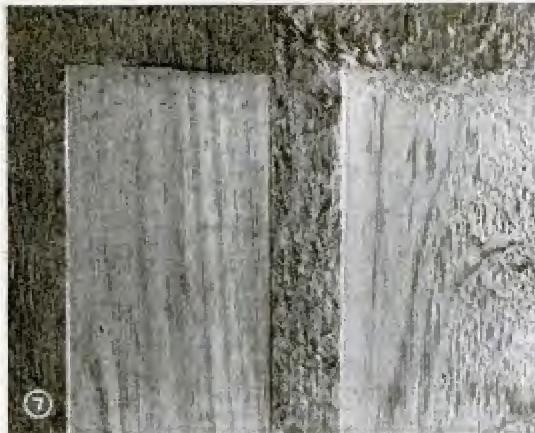
Name of Wood	General Characteristics						Machining					Remarks
	Weight Per Cubic Foot (1)	Hardness	Strength (2)	Stability (3)	Gluing	Nailing (4)	Steam Bending	Planing and Jointing (5)	Turning (6)	Sanding (7)	Shaping	
Ash	35	Med.	Med.	Best	Fair	Good	Good	Good 10-25	Fair	Best 2/0	Best	Fair
Basswood	24	Soft	Weak	Good	Best	Best	Poor	Good 20-30	Poor	Poor 4/0	Poor	Fair
Beech	39	Hard	Med.	Poor	Poor	Poor	Good	Fair 10-20	Fair	Good 4/0	Fair	Best
Birch	40	Hard	Strong	Good	Fair	Poor	Good	Good 15-20	Good	Fair 4/0	Best	Best
Butternut	25	Soft	Weak	Best	Good	Fair	Poor	Good 10-25	Good	Fair 4/0	Fair	Fair
Cherry	36	Med.	Med.	Good	Best	Fair	Poor	Best 10-25	Best	Best 4/0	Best	Best
Chestnut	27	Soft	Weak	Best	Best	Good	Fair	Good 15-20	Best	Best 3/0	Good	Good
Cottonwood	27	Soft	Weak	Fair	Best	Best	Poor	Poor 5-20	Poor	Poor 4/0	Poor	Fair
Cypress	29	Soft	Med.	Good	Fair	Fair	Poor	Good 15-25	Poor	Fair 2/0	Poor	Poor
Elm (Southern)	34	Med.	Med.	Poor	Fair	Best	Good	Poor 15-20	Poor	Good 2/0	Poor	Good
Gum (Red)	33	Med.	Med.	Poor	Best	Good	Fair	Fair 10-20	Best	Fair 4/0	Fair	Fair
Hickory	42	Hard	Strong	Good	Good	Poor	Good	Good 10-25	Good	Best 2/0	Fair	Best
Magnolia	30	Soft	Weak	Fair	Best	Best	Best	Good 5-15	Fair	Good 4/0	Good	Poor
Mahogany	35	Med.	Med.	Best	Best	Good	Poor	Good 5-25	Best	Good 4/0	Best	Best
Mahogany (Phil.)	33	Med.	Med.	Best	Best	Good	Poor	Good 5-25	Good	Poor 3/0	Fair	Fair
(9) Maple (Hard)	41	Hard	Strong	Good	Fair	Poor	Fair	Fair 15-20	Good	Good 4/0	Best	Best
Maple (Soft)	31	Med.	Med.	Fair	Good	Fair	Fair	Poor 10-15	Fair	Good 4/0	Fair	Poor
Oak (Red)	39	Hard	Strong	Best	Good	Good	Best	Best 10-25	Good	Best 2/0	Fair	Best
Oak (White)	40	Hard	Strong	Best	Good	Good	Best	Best 10-20	Good	Best 2/0	Good	Best
Pine (White)	25	Soft	Weak	Good	Best	Best	Poor	Good 10-25	Good	Fair 2/0	Good	Fair
Pine (Yellow)	38	Hard	Strong	Fair	Fair	Poor	Poor	Good 10-25	Poor	Fair 2/0	Good	Good
Poplar	29	Soft	Weak	Good	Best	Best	Fair	Good 5-20	Good	Poor 4/0	Poor	Fair
Redwood	29	Soft	Med.	Best	Best	Good	Poor	Good 10-25	Fair	Poor 2/0	Good	Poor
Sycamore	35	Med.	Med.	Poor	Good	Best	Poor	Poor 5-15	Good	Poor 3/0	Poor	Best
Walnut	36	Med.	Strong	Best	Best	Fair	Good	Good 15-20	Best	Best 4/0	Good	Best

NOTES

- Data in this chart is largely from extensive tests made by U. S. Forest Products Laboratory, with some additions.
1. Pounds per cubic foot, dry. All woods vary in weight, even in the same tree from trunk to top. A variation of 10% over or under average should be allowed.
 2. Composite strength value. Woods rated weak are strong enough for all average work.
 3. Rated on unrestrained warp. Most woods are quite stable if properly seasoned and cared for.
 4. Rated on ability to take nails near end without splitting.
 5. All flat grain stock, shallow cut. Rating is average

from runs at 15, 20 and 25-degree cutting angles. Bottom figure is best knife angle for smooth cutting.

6. Rated on smooth cutting and ability to hold detail. Not much difference between best and good.
7. Rated on freedom from fuzz. Bottom figure is coarsest abrasive grit which can be used without scratching.
8. Rated on smoothness of cut. Work speed decreases with hardness of wood and this factor might be of more importance than smoothness in production work.
9. Sugar, white or hard maple. Should be distinguished from silver, red, big-leaf or soft maple, which is an inferior machining wood although often marketed simply as "maple."



JOINTING IS THE SEVEREST TEST OF THE WOOD'S ABILITY TO MACHINE. BETTER CUTTING CAN OFTEN BE OBTAINED BY CHANGING RAKE ANGLE OF KNIVES

fan, Fig. 5. The flat-cut boards always curl away from the heart and the square timber shrinks badly on one side, but the quartersawed board is quite stable. From these observations, it is apparent that quartersawed lumber is preferable for maximum stability. Also, if the board is cupped, it is certain that the rounded side is the heart side. Fig. 2 shows how the end grain indicates the type of sawing. Quartersawed lumber also is known as radial-cut, edge-grain, rift-grain and comb-grain. Flat-cut lumber is variously named slash-grain, bastard-grain, plain-sawed and tangential cut.

The right side: When using flat-cut lumber, keep the heart side toward the outside surface of the work. Then, if the board does cup, it will show rounded on the face, which is much better than a hollow and much stronger structurally. An exception is painted wood used outdoors. Paint holds better on the bark side and there is less danger of the grain shelling out.

Moisture content: Wood for furniture will be stable if the moisture content is from 6 to 8 percent. This is obtained automatically if the wood is stored for three or four weeks in the same atmosphere at which it will be used. Lumber from commercial dry kilns has a moisture content of about 8 percent. Lumber air-dried outdoors will have a moisture content of about 20 percent, and should not be used for furniture until it has seasoned three or four weeks indoors. Sometimes it is a good idea to check the moisture content of wood before using it. Weigh a small sample exactly and then put it in the kitchen oven. Check the weight at intervals until the wood ceases to lose weight. Ascertain the weight difference and divide by the original weight to get the moisture content. For example, if the test piece weighs 10 oz. at the start and 8 oz. oven dry, the difference is 2 oz., representing moisture, or 20 per-

cent moisture content. The test can be done in a half hour by splitting the sample into thin strips to hasten drying.

Machining: Some woods machine much better than others. Note in Fig. 7 how walnut takes a smooth jointer cut, while soft maple is very rough. Suitability of various woods for machining is indicated in Table No. 1. Jointing, Fig. 9, is the most important test. Other than the wood itself, the method of machining affects the finished work. This can be observed in jointing, where much better work often can be done by changing the rake angle of the knives. Most small jointers have the knives fixed at about 30 degrees rake. This is excellent for knife efficiency, but the sharp angle tends to tear the grain of many woods. For production work in these woods it is advisable to reduce the rake angle by using shims or grinding a front bevel as shown in Fig. 8. Other useful characteristics of woods are given in the table. The "hardness" column lists woods according to whether they are physically hard or soft. Generally, the botanist's classification of hardwoods (broad-leaved trees) indicates a physically hard wood, but there are several exceptions, including such hardwoods as basswood, poplar, cottonwood and aspen, all of which are quite soft. Exceptions in reverse also will be found. Yellow pine, for example, although botanically a soft-wood (coniferous or needle-leaved trees), is actually harder than many hardwoods. If the wood is hard, it is always heavy without exception; if the wood is hard, it generally is strong.

Table No. 2

WOODS-FINISHING DATA

Note: NGR = Non-Grain-Raising
(Applies to stain)

	Natural Color	Usual Grain Figure	Stain		Filler		Bleach	Paint	Natural Finish	Remarks
			Type (1)	Color	Wt. (2)	Color				
Alder (Red)	Pink to Brown	Plain or Figured	Wiping or Water	Red or Brown	None	Yes	Yes	Yes	Principal hardwood of Pacific coast. Like red gum.	
Amaranth (Purpleheart)	Purple	Mild Stripe or Mottle	None	None or 6	Match Wood	No	No	Yes, Pref.	Usually finished natural to retain purple color.	
Ash (U.S.A.)	White to Brown	Plain or Fiddleback	Any	Any	15	White or Brown	Yes	Yes, Fill First	White filler used for frosted finish (3).	
Basswood	Cream	Very Mild	NGR	Red or Brown	None	Not Nec.	Yes	No	Fuzzy grain. Usually muddy under oil stain.	
Birch	Cream	Mild	Any	Walnut or Mahogany	8	Natural or Brown	Yes	Yes, Interior	Used extensively for walnut and mahogany.	
Butternut	Heart: Amber Sap: Cream	Like Walnut	Water	Walnut or Oak	14	Medium Brown	Yes	No	Good for amber walnut without bleaching.	
Cedar (Aromatic Red)	Heart: Red Sap: Cream	Knotty	None	None	No	No	Yes, Pref.	Red wiping stain can be used to blend sap wood.		
Cherry	Red to Brown	Good	Water	Red or Brown	6-8	Red to Black	No	No	Takes excellent finish. Good for brown mahogany.	
Chestnut	Gray-Brown	Heavy Grain	Oil or Wiping	Red or Brown	15	Red or Brown	No	Yes	Large pores. Good for novelty finishes (3).	
Cypress	Heart: Brown Sap: Cream	Plain or Figured	Water, Oil or Wiping	Red or Brown	None	No	Yes (6)	Yes	Good for sand blast (4). If water stained, see (5).	
Ebony	Dark Brown to Black	Plain or Stripe	NGR	Dark Red or Brown	None or 3	Brown or Black	No	No	Oil. Gaboon ebony is blackest.	
Elm (Southern)	Brown to Cream	Heavy Grain	Water	Red or Brown	12	Dark Brown	No	Yes	Cross-grained. Sometimes hard to get even color.	
Fir (Douglas)	Cream to Red	Plain or Wild	Wiping or Oil	Brown	None	No	Yes (7)	No	Good for sand blast (4). Not pleasing stained.	
Gum (Red)	Heart: Br. Red Sap: Cream	Plain or Figured	Any	Red or Brown	None or 3	Match Wood	Yes	Yes	Most used wood for walnut and mahogany imitations.	
Hickory	White to Cream	Usually Straight	Water	Red or Brown	15	Brown	Yes	No	Good walnut or mahogany -blond finishes.	
Holly	Silver White	Mild	Water	Amber	None	Not Nec.	Yes	Yes	One of the whitest woods. Usually finished natural.	
Magnolia or Poplar	White to Yellow	Mild	Oil or Water	Red or Brown	None	No	Yes	No	Usually painted. Makes fair satinwood imitation.	
Lacewood (Silky Oak)	Medium Brown	Flake	Water	Oak or Lt. Walnut	12	Dark Brown	Fairly Well	No	Yes	Excellent cabinet wood. Very decorative.
Mahogany	Brown to Red-Brown	Stripe	Water	Red or Brown	12	Red to Black	Yes	No	Best known cabinet wood. Excellent for finish.	
Mahogany (Philippine)	Brown to Red-Brown	Stripe	Water or Wiping	Red or Brown	18	Red to Black	Yes	No	NGR stain preferable to minimize grain-raising.	
Maple	Cream	Varied	Water and Wiping	Maple	None	Yes	No	Yes	Use NGR stain and tone with wiping stain after sealer.	
Oak (English Brown)	Deep Brown	Plain, Flake or Swirl	NGR	Brown	15	Brown to Black	Yes	No	Yes	One of the best cabinet woods. Also "Pollard Oak".
Oak (Red)	Red-Brown	Plain or Flake	NGR	Green Toner (8)	15	Brown	Yes	Yes	No	Bad grain-raising with water stain, hence NGR stain preferable. Good for novelty finishes (3).
Oak (White)	White to Light Brown	Plain or Flake	NGR	Brown	15	Brown	Yes	Yes	Yes	
Orientalwood	Light Brown	Stripe Crossfire	Water	Amber or Brown	12	Brown	No	No	Yes	Good walnut effects.
Pine (White)	White to Cream	Mild	Water (5) or Oil	Brown Only	None	No	Yes	No	Best for painting.	
Prima Vera	Yellow-White	Stripe Crossfire	Water	Amber	12	Natural or Dark	Yes	No	Yes	Also "White Mahogany". Excellent "blond" color.
Redwood	Red	Mild St. Grain	Red only for toning	None	No	Yes	Yes	Yes	Excellent exterior wood. Best painted.	
Rosewood (Brazil)	Red-Brown	Varied	NGR	Red	15	Dark Red or Black	No	No	Yes	Oil. Wash off with lacquer thinner before staining or finishing.
Rosewood (East Indies)	Red-Purple	Stripe	NGR	Dark Red	12	Dark Red	No	No	Yes	
Sapele	Medium Brown	Stripe	Water	Red or Brown	10	Dark Brown	No	No	Yes	Very similar to striped mahogany.
Sycamore	White to Pink	Flake	Water	Amber or Brown	None	Seldom	Yes	Yes	Good for natural finish.	
Walnut	Heart: Brown Sap: Cream	Varied	Water	Walnut	14	Brown to Black	Yes	No	Yes	Obtainable in all figures.
Zebrawood	Tan with Brown Stripe	Heavy Stripe	Water	Light Oak	12	Natural	No	No	Yes	Very pronounced grain. Good for modern effects.

NOTES

- Where water stain is indicated, NGR (non-grain-raising) stain can also be used. "Oil" means penetrating oil stain; "wiping" means wiping oil stain.
- Pounds of filler paste per gallon of thinner.
- All coarse-grain woods are good for novelty finishes, using contrasting filler, usually white.
- Woods with alternate hard and soft streaks can be sand-blasted or burned with torch to cut out soft wood.
- Water stains take better on resinous woods if wood is first sponged with 4 oz. sal soda and 1 oz. washing soda to gallon of water.
- Add 1 pt. benzol per gal. of paint for better penetration (primer only).
- Special sealers available to kill grain.
- For brown tones, first spray weak green stain to kill red color of wood.

Finishing: Finishing often is the prime characteristic in selecting a cabinet wood. When you have a wood that machines and finishes nicely, then you have a top-notch cabinet wood. Information given in Table No. 2 will help in selecting a wood for finish, and is a fair guide as to how the wood should be finished. Finishing is closely related to the natural beauty of the wood, necessitating some knowledge of grain and "figures" for suitable selections. Figures in wood constitute a whole subject in themselves, and the few samples shown in Figs. 10 to 16 can be taken only as typical examples. Perhaps the best way to become acquainted with figures and also the many different kinds of woods is to purchase a set of wood samples, Fig. 6. A set of fifty samples is an inexpensive and worthwhile investment, and it is surprising how quickly identification and general knowledge of various woods can be learned by "leafing" through such a set. The samples are small wood blocks packaged in a neat box and should be kept in a clean, dry place.

Grading of wood: A knowledge of wood grading is useful. For example, if you want a poplar board for painting, you would order "stained saps," (fifth-grade lumber), and the finished job would be practically as good as if made from "firsts and seconds." Essential grading data is given in Table No. 3. This table is not complete nor absolutely accurate, but it can be taken as a general guide. There are actually ten grades of lumber. Of these, eighth and ninth grade mahogany is the only one of interest to the crafter. This grade comprises wood of firsts and seconds quality but in short lengths. It should be noted in the table that numbered gradings are not comparable between different woods. For example, fifth grade poplar is a much better wood for a paint job than fifth grade chestnut. Grading rules for softwoods are much different than for hardwoods, and the differences should be carefully noted from the table.

Table No. 3 GRADING OF WOODS (Condensed)

Hardwoods	General Grading—Indicates let-down in quality					
	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Ash, Beech, Birch, Hard Maple, Red Alder	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	Sound Wormy	
Cherry	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	
Chestnut	Firsts and Seconds	Selects	No. 1 Common	Sound Wormy	No. 2 Common	
Cottonwood, Red Gum	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	
Elm, Hickory	Firsts and Seconds	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common	
Mahogany	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3 Common	
Red Oak, White Oak Locust, Sycamore	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	Sound Wormy	
Poplar	Firsts and Seconds	Saps	Selects	Stained Saps	No. 1 Common	
Walnut, Butternut	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3 Common	
Firsts—About 91% clear both sides.		Selects—90% clear one side.				
Seconds—About 83% clear both sides.		No. 1 Common—About 75% clear face.				
Firsts and Seconds—Best commercial grade. Not less than 20% firsts.		No. 2 Common—About 66% clear face, Sound Wormy—No. 1 common but with wormholes.				
Softwoods	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Boards	A Select	B Select	C Select	D Select	No. 1 Common	No. 2 Common
Dimension Stock	No. 1 Common	No. 2 Common	No. 3 Common			
A Select—Clear and suitable for natural finish. B Select—Allows a few small defects but suitable for natural finish. C Select—Allows a few defects which can be covered by paint. D Select—Allows any number of defects, which can be concealed by paint. No. 1 Common—Sound and tight-knotted wood						



PENCIL STRIPE

(10)



RIBBON STRIPE

(11)



MOTTLE

(12)



QUILTED

(13)



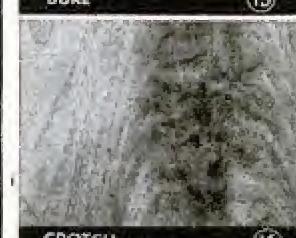
FLAKE

(14)



BURL

(15)



CROTCH

(16)

FIGURES IN WOOD ARE VARIED WITH ABOUT 25 RECOGNIZED STYLES, A FEW OF WHICH ARE SHOWN ABOVE

"Hedge" of Morning-Glory Vines Is Neat and Attractive

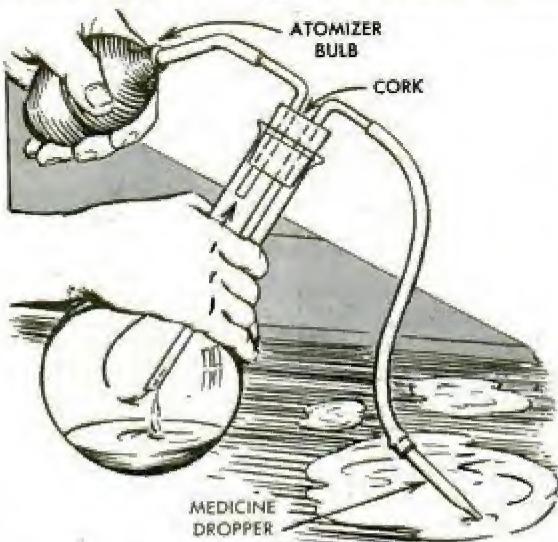


An inexpensive but very attractive "hedge" can be grown by training morning-glory vines on stakes and cord. In the spring, just drive forked stakes into the ground at 3-ft. intervals along the desired hedge line. Then stretch strong cord from one stake to another and sow morning-glory seeds directly below the cord. As these vines climb the stakes and twine around the cord, they form a graceful garland between each stake.

—Mrs. George Rundle, Batavia, Ill.

Spilled Mercury Easily Salvaged With Flask and Tube Siphon

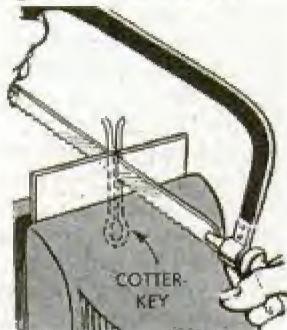
Spilled mercury is gathered up efficiently with this siphon, even when small drops are scattered over a large area. A tight-fitting stopper, with glass tubes inserted as



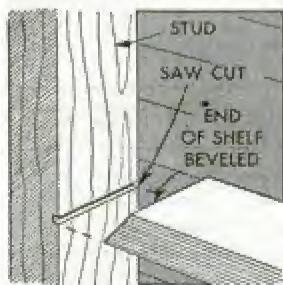
shown, is placed in a flask. A rubber tube to which a medicine dropper has been attached is slipped over the end of the longer glass tube, and another rubber tube carrying an atomizer bulb is attached to the second glass tube. In use, the bulb is squeezed and the medicine dropper placed in the spilled mercury. When the bulb is released, the mercury will be drawn into the flask. Dirt which may also be drawn in can be skimmed off with filter paper.

Cotter Key in Vise Guides Saw When Cutting Sheet Metal

To help stiffen thin sheet metal held in a vise and guide the saw for a straight cut, one mechanic employs a cotter key as shown. The key is clamped behind the metal where the legs serve as a saw guide.



Installing Shelves Between Studs



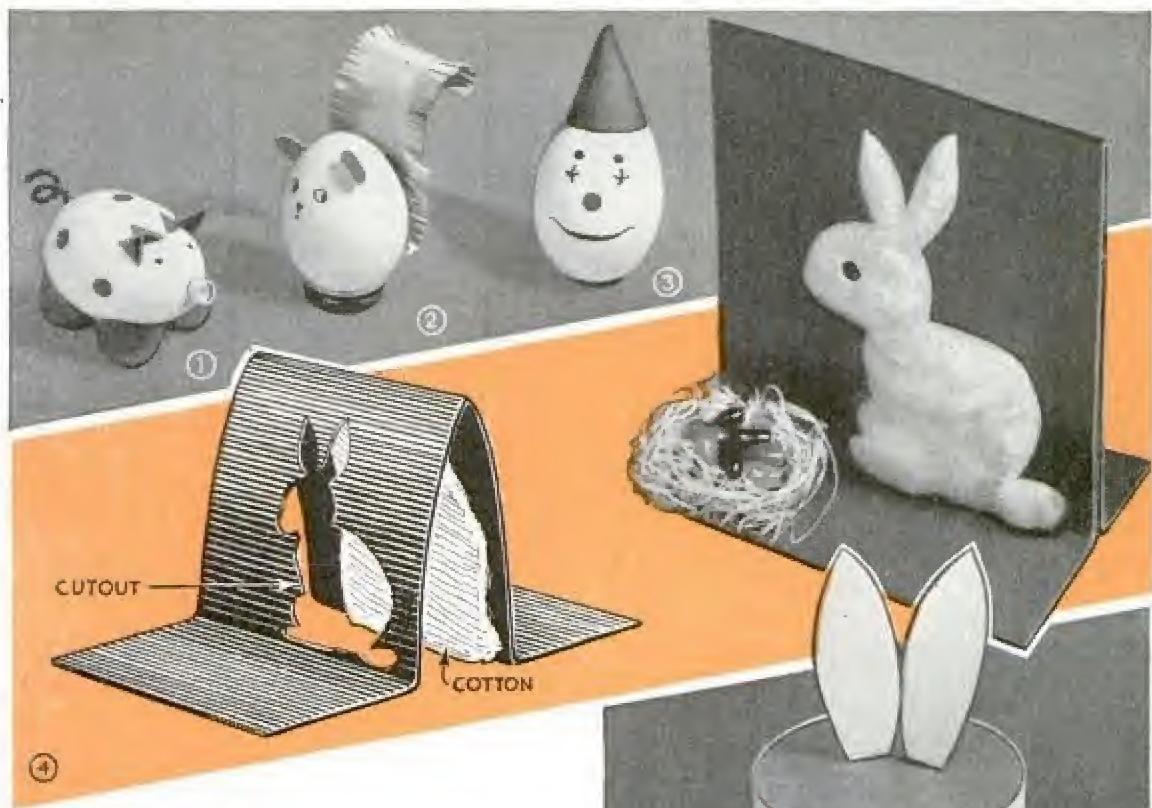
When it is desired to fit narrow shelves between building studs you can eliminate the usual cleating-and-nailing procedure by making a $\frac{1}{16}$ -in. saw cut in each stud at the point where you want the shelf. Bevel each end of the shelf, making it about $\frac{1}{8}$ in. longer overall than the distance between the studs. Then, simply drive the shelf in place.

Emergency Bottom for Bucket

There's no use in discarding a coal bucket or other container used for carrying nonliquid material just because the bottom has rusted out. All you have to do is cut a wood disk to reinforce the present bottom. Driving three or four short nails through the bottom into the wood will hold the latter in place. If the container is a coal bucket, a disk of tempered hard-pressed board, which does not ignite easily, used instead of the wood will enable you to carry hot ashes.



Favors and Centerpieces for Your Easter Party



It's easy to make these appropriate favors and table decorations for Easter. The humorous trio pictured in Figs. 1, 2 and 3 are made from empty eggshells, or hard-boiled eggs may be used. Porky the pig in Fig. 1 has paper ears, a macaroni-ring snout, date legs, ink dots for his spots and eyes, and a yarn tail. Perched atop an inverted bottle cap, the alert little squirrel is made from a brown-shelled egg or one dyed brown. His tail consists of a 4-in. strip of brown paper, fringed and curled. Ears are cut from the same material, and the features are inked on. The grinning clown utilizes an empty egg shell and owes his upright position to a small stone which was dropped gently through the hole made for removing the egg contents. The peaked paper cap gives him a saucy air and effectively hides the hole. He has a dot nose and India-ink eyes and mouth. Appearing real enough to cuddle, the bunny in Fig. 4 is made from paper and cotton. Use soft pastel mat stock for the folder, cutting a strip 5 by 10 in. Fold the strip at the center and then fold back the ends to form a support. Make a bunny cutout in the front of the folder and glue a pad of cotton to the inside back of it. Then glue the edges together. The cotton will fluff out through the cutout to make a realistic looking bunny. Use pink felt, flannel or paper for the eye and shape a nest from a few wisps of colored excelsior.

The dignified little bunny centerpiece in Fig. 5 is made from a salt carton covered with white felt, flannel or paper. The ears and feet are cut from the same material. Eyes and nose should be bits of pink material. Give him a dainty pink or blue necktie of ribbon or yarn. If desired, the bottom may be removed from the carton and tiny favors or gifts placed inside.

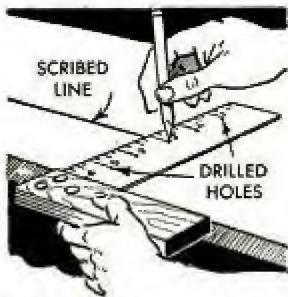
A substitute scouring pad can be made from a 3 or 4-ft. length of furnace chain. Thread a fine wire or strong cord through the chain links at 5-in. intervals, bunch the resulting chain loops to form a pad and tie the ends of the wire or cord tightly.

Vertical Dowel Rods in Table Top Hold Rolled Blueprints



Lacking rubber bands to hold rolled blueprints conveniently at hand on his work table, one draftsman slips them over dowels projecting from the table near the rear edge. The dowels are spaced only $\frac{1}{2}$ in. from the wall so that prints slipped over them cannot unroll.

Try Square Converted for Use As a Marking Gage



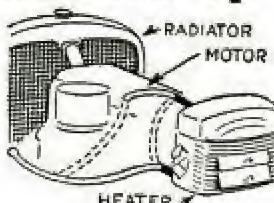
Holes drilled at each of the inch marks in the metal rule of a square make it possible to use the square to mark off long lengths of lumber more accurately. Inserting the pencil through the

hole at the proper mark as shown enables you to use the square as a marking gage.

—Pvt. Cliff Tambyll, Champaign, Ill.

Speedy Car-Heater Hook-Up

A fast way of disconnecting a car hot-water heater without the aid of shut-off valves or plugs is merely to double the hose connections back on themselves. That is, one engine-to-heater hose is disconnected at the engine and doubled right back onto the heater as indicated by the dotted lines. Then the other hose is disconnected from the heater and placed on the engine con-

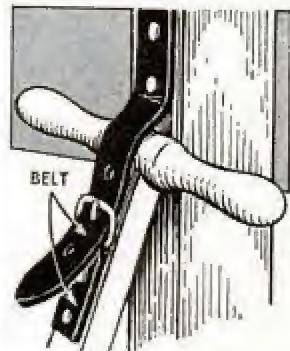


nnection from which the first hose was removed. The hose is kept from drying out or becoming lost, and is instantly available when reconnecting the heater.

Lawnmower Held Against Wall By Strapping It to Stud

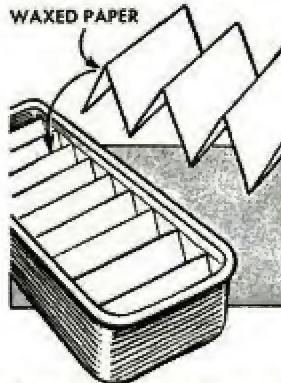
To keep small children from playing with his lawnmower, one homeowner strapped it to his garage wall with a discarded trouser belt as shown. The buckle portion of the belt was tacked to the handle of the mower and the strap end

to the stud of the wall. By holding the handle of the mower against the stud and inserting the strap through the buckle, the mower may be fastened securely.



Long Ice Cubes Are Convenient

WAXED PAPER



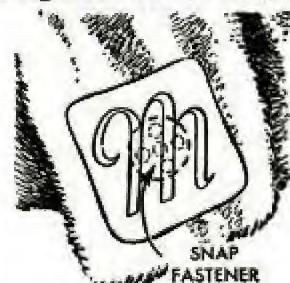
Long, triangular pieces of ice that will slip easily into the mouth of a vacuum bottle can be made by providing new dividers for your refrigerator ice trays. Merely fold a long strip of heavy waxed paper into pleats as shown and slip

them into the tray after it has been filled with water. When frozen, the sections can be parted with the fingers.

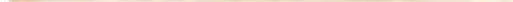
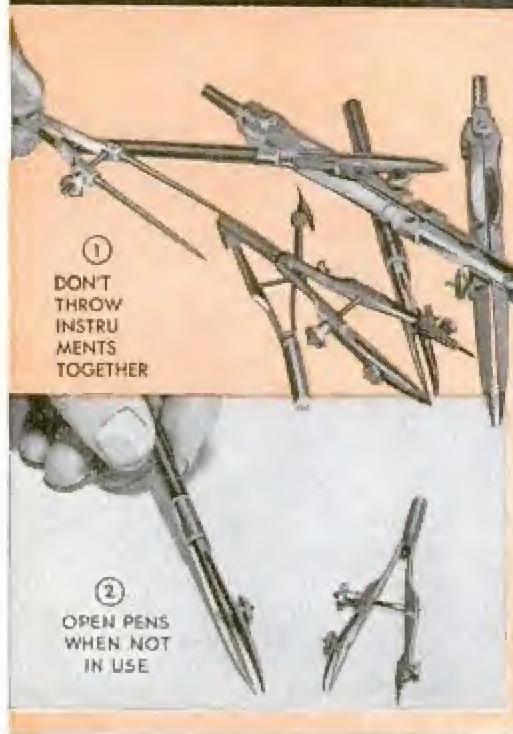
Removable Monogram for Towel

In a large family where it is impossible to give each member towels of different colors for identification, a handy way of identifying each towel is to sew one half of a snap fastener on one corner of the towel, the other half being sewed to a bit of cloth having the initials of the owner embroidered on it. In this way, the initials can be removed for laundering and then placed on any towel.

—M. W. Kendziorek, Colon, Panama.



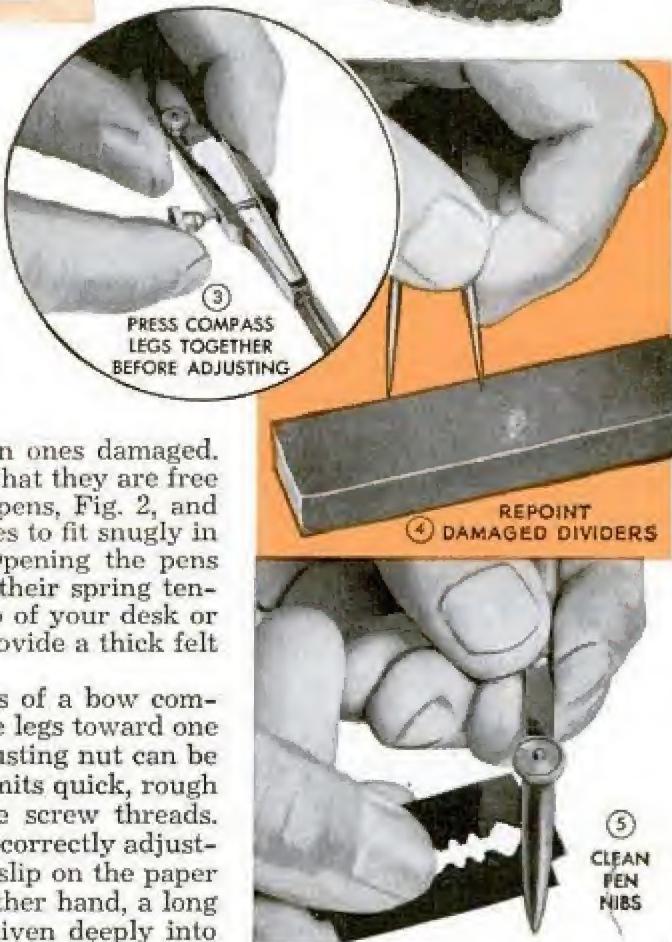
Take Care of Your **DRAFTING TOOLS**

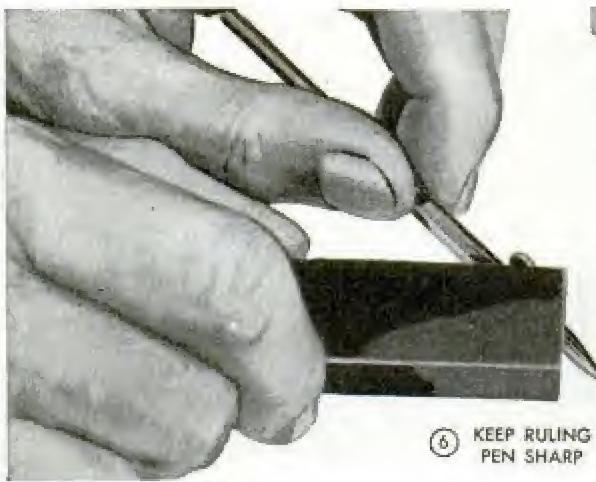


By Harry Radzinsky

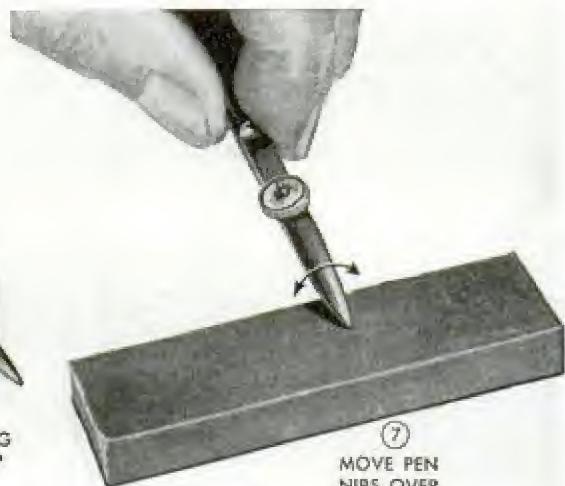
IF A well-made set of drafting instruments is used and cared for correctly, they will last practically a lifetime. Rust is the enemy of all fine tools. Therefore, drafting instruments should be stored in their case and kept in a dry place when not in use. Throwing them together as in Fig. 1, in a drawer or on a table is bad practice, as they may become bent and the points of certain ones damaged. When placing tools in the case, see that they are free from ink, open the nibs of ruling pens, Fig. 2, and spread the legs of the bow compasses to fit snugly in the recesses provided for them. Opening the pens and compasses in this way lessens their spring tension. If you spread the tools on top of your desk or work table, it is good practice to provide a thick felt pad on which to place them.

When opening or closing the legs of a bow compass for rough adjustment, press the legs toward one another as in Fig. 3 so that the adjusting nut can be spun freely with a finger. This permits quick, rough adjustment and saves wear on the screw threads. Always keep compass needle points correctly adjusted. If the point is too short it may slip on the paper and let the compass skid. On the other hand, a long projecting point will have to be driven deeply into





⑥ KEEP RULING PEN SHARP



⑦ MOVE PEN
NIBS OVER
STONE WITH
ROLLING MOTION

the paper to permit the pen or pencil point to reach the paper. A needle point that projects about $\frac{1}{64}$ in. more than the pen or pencil point will be found most satisfactory. Should you damage a needle point that is not of the separable or replaceable type, you can repoint it with a small honing stone. Both legs of dividers should be re-pointed in this manner, Fig. 4, so that they will be exactly the same length.

It is best not to fill a ruling pen to a depth of more than $\frac{1}{4}$ in. An overfilled pen is likely not only to cause blots, but the ink will thicken or dry in the pen before it is used up. Ink should not be permitted to harden in a pen, as it will reduce the width of the lines made with the pen. A soft lintless cloth makes the best pen wiper. However, if ink has dried and hardened between the nibs of a ruling pen or compass, it should be scraped out with a wafer-type, safety-razor blade, Fig. 5, first opening the nibs as widely as possible. Light pressure

is used on the blade in order not to dull the edges of the nibs.

When used with ink of the proper consistency, a ruling pen should be capable of producing a fine hairline. After the pen has had some use, it may require sharpening. This is easy to do on a fine-grained oilstone as in Figs. 6 and 7. In doing this, the first step is to close the nibs until they touch each other; then run their ends over the stone carefully to bring them to the same length and give them their proper oval shape. When this has been done, the nibs are spread, after which one of them is held with the convex side against the stone and is moved over the stone with a rocking motion to follow the curvature of the nib and bring it to a sharp edge. Then the pen is turned over and the second nib treated in the same way. Do this carefully and check the work frequently as grinding progresses.

Clothespin Rack Holds Drinking Cups Near Water Cooler

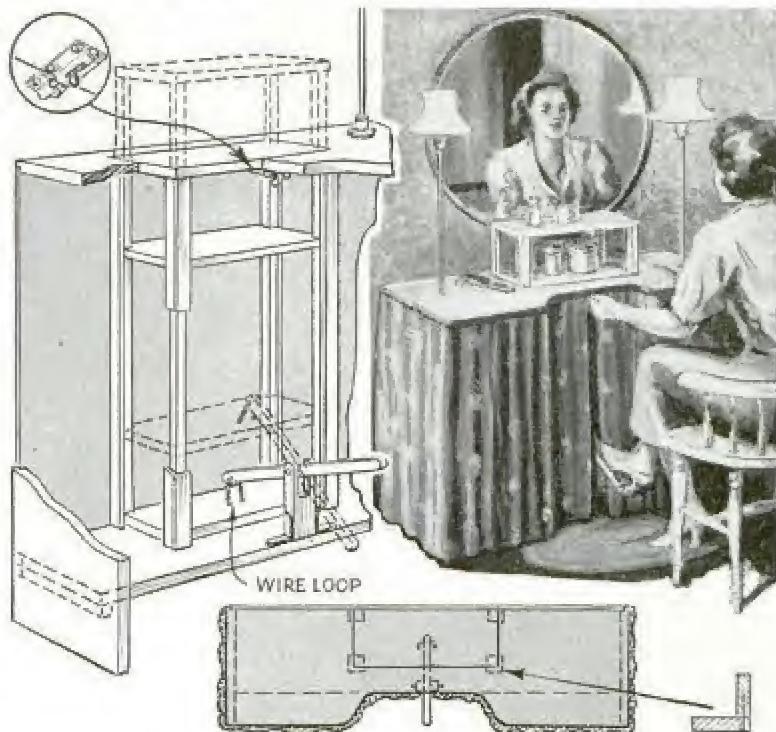
In one small factory where the workmen disliked the small envelope type of drinking cup, which was used once and then discarded, it was decided to put in a dispenser of better grade cups that could be used several times before discarding them. To assure that each workman would use only his own cup, spring-type clothespins were screwed to a board, which was then nailed to the wall near the water cooler to hold the cups, the workmen's names being printed under the clothespins as indicated. The clothespins hold the cups in an inverted position which helps keep out dust.

CWhen painting or varnishing the inside of a boat, rub down the finish with sandpaper instead of steel wool, as small pieces of the latter may remain in the boat and later rust and cause unsightly spots.



Cosmetic Tray in Vanity Raised When Needed

This dressing table features a central section that can be elevated at the touch of the foot, raising a shelf from below the table level which holds cosmetics, bobby pins and other items. The body of the table itself can be made by covering a packing box of suitable size or by building a frame of light material covered with plywood or hard-pressed board. Corner posts of the elevator are made of $\frac{3}{4}$ -in. quarter round. The whole elevator assembly slides up and down a "track" formed by $\frac{1}{4}$ -in. stock. Pressing the foot on the lever brings the second shelf into position and a barrel bolt underneath keeps it in place.

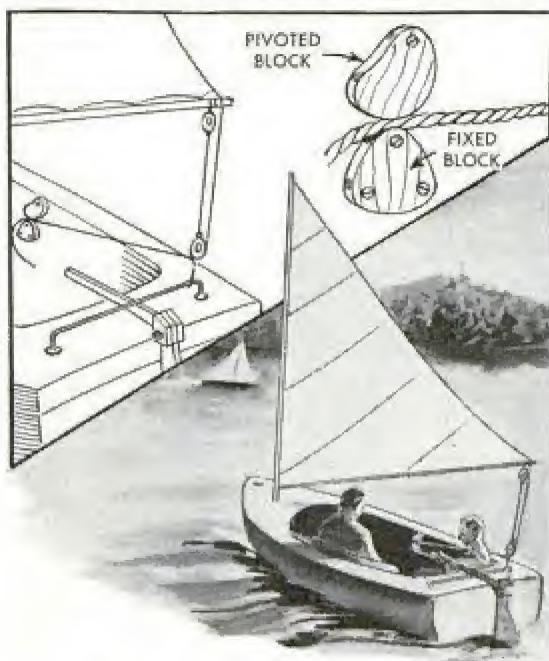


Instantaneous Sheet-Rope Release for Small Sailboats

Being able to release the main sheet instantly, when handling a small sailboat in a stiff breeze, may mean the difference between a capsize and a safe maneuver. This simple holder will grip the sheet rope tightly under strain, but will let go immediately when the strain is removed. The holder consists of two hardwood blocks shaped as shown and fastened in a convenient place

inside the gunwale. As indicated, one block is screwed in a fixed position and the other is pivoted directly above it in such a position that when the sheet rope is placed between the blocks and pulled sternward the top block will be pulled in toward the bow and pinch the rope. Instant release is obtained by jerking the slack sheet forward so that the pinch is broken. Then the rope will be shaken out from between the blocks and run free.

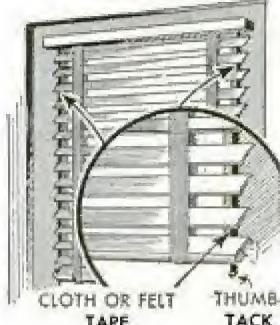
—L. B. Robbins Harwich, Mass.



Silencing Venetian Blinds on Door

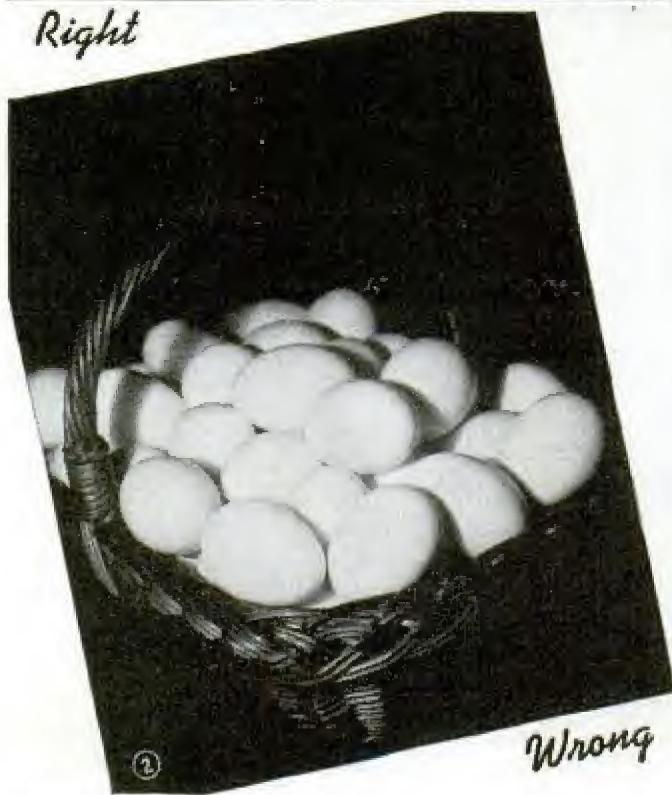
Do venetian blinds on one of your doors make an annoying noise or strike the door and mar its finish every time it is closed? You can prevent this easily by putting strips of cloth or thin felt on the door where the blinds strike it. A couple of thumbtacks for each strip will hold it in place. Being behind the blinds, the cloth will be unnoticeable, especially if its color matches that of the door.

—George Mullin, Tulsa, Okla.





Right



Wrong



THREE - Effects in

DIFFERING from the true three-dimension effects obtained with stereoscopic cameras and viewers, you can produce illusions of three dimensions with a single-lens camera by means of simple tricks such as the use of lights and shadows to get depth impressions, and by "framing" photos. The basic difference between stereoscopic pictures and simulated three-dimension effects lies in the fact that stereoscopic cameras have two lenses about $2\frac{1}{4}$ in. apart (same as average distance between a pair of human eyes), which makes it possible to take two pictures of the subject from slightly different angles. When the resulting pictures are mounted side by side and viewed through two similarly spaced lenses, stereoscopic effects often are phenomenal. However, these effects cannot be observed simultaneously by groups and have not been found practical for regular magazine reproduction, with the result that stereoscopes have been abandoned more or less in favor of just ordinary photos taken with single-lens cameras. As these

Wrong

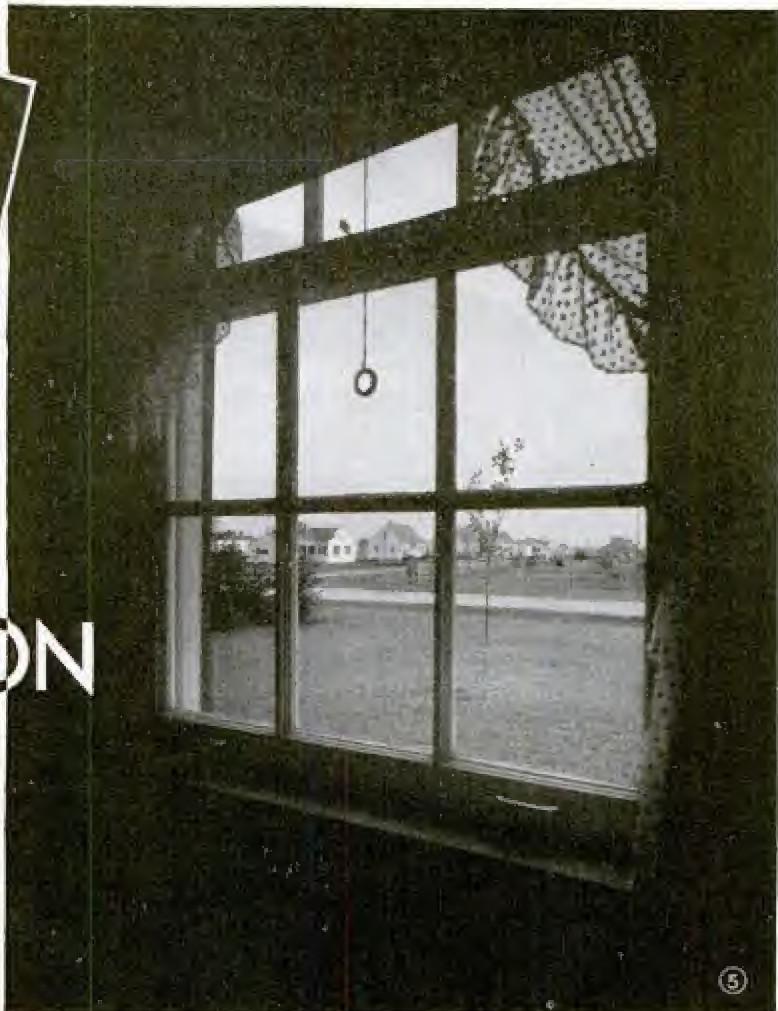


DIMENSION *Your Photos*

by Fred G. Korth

cannot look slightly around an object like a pair of human eyes or like stereoscopic cameras, photos taken will appear as if the subject were viewed with one eye shut. Therefore, to obtain three-dimension effects you must resort to good observation and tricks to bring out depth in your photos, thus creating the illusion of a third dimension.

Most important is correct lighting. Assuming that you know what subject you are to photograph, how long to expose a certain kind of film and how to process the film and paper in the darkroom, it is lighting that makes the pictures good or bad, and gives them either the depth you want or results in the flatness you try to avoid. Photos having depth must "lure" the observer to look into instead of at them. The easiest way to produce such photos is to place the light at the far end. Then the eyes of an observer wander through the dark space in the foreground into the distance where the center of interest has been highlighted. If some dark object is more



"Framing"





or less silhouetted in front, the observer tends to reach around and beyond it into the brighter distance. The result is definitely an illusion of depth, which should be credited to good judgment in lighting.

As examples of what can be done with good and bad lighting compare Figs. 1 and 2. Both of these are photos of eggs in a basket. The charm of Fig. 1 lies in the fact that this very ordinary subject matter has been lighted in an unusual manner. The eggs in the foreground and also the front of the basket itself are silhouetted. Lighting accentuates the middle distance. Eyes of the observer are led to this bright spot. This picture has many tone values from black to white and the large black area helps to emphasize the limited light area, which is the center of interest. In Fig. 2 all of this charm is lost. The light has been directed at the front of the basket from a position next to the camera. The eggs have lost most of their roundness and many of their outlines are not distinguishable. The lack of middle tones gives this photo all the characteristics of so-called "soot-and-whitewash" photos.

Figs. 3 and 4 represent two shots of the same little kitchen. Even though the photographer has avoided the absolutely bad placement of the light alongside the camera, there is a distinct difference between the two positions of the light. In Fig. 3 it is located at the far end of the picture, where it belongs for depth effect, while in Fig. 4

it is located in the foreground of the kitchen. Notice that the distance appears shorter in Fig. 4 than it does in Fig. 3.

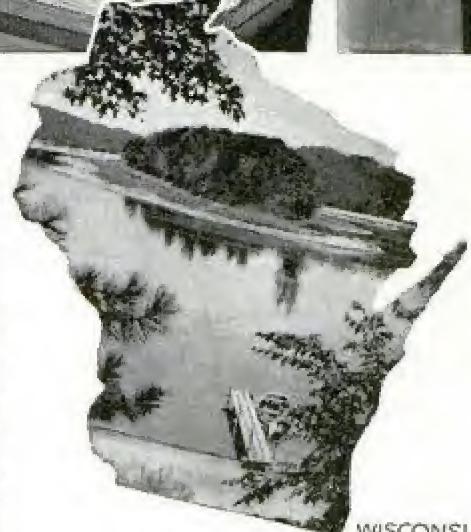
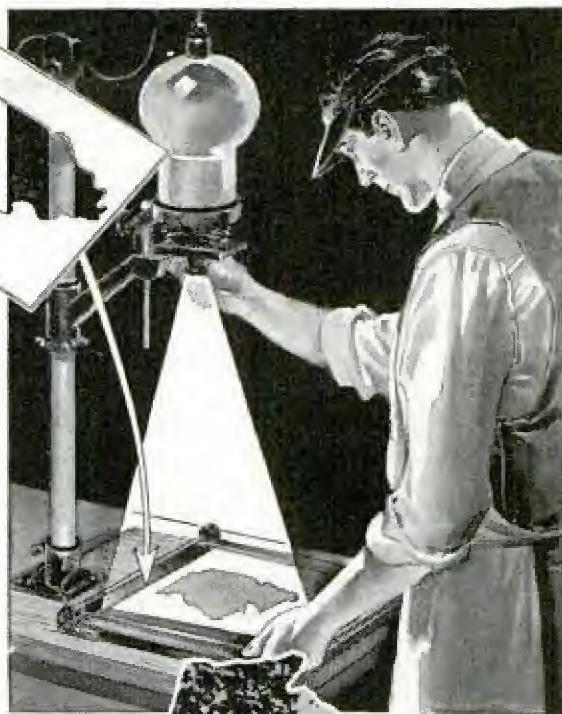
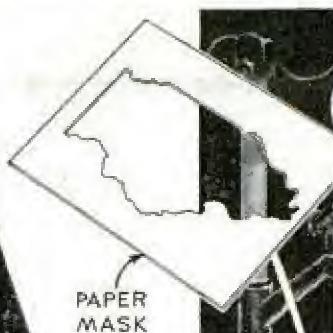
Framing a picture within a picture is illustrated in Figs. 5 and 6. Imagine a number of little houses strung out into the distance and nothing but grass for the background with a large expanse of sky and not much sun above. Then view the same scene through a window as in Fig. 5, which not only adds a part of one of the houses, but also the illusion of three dimensions. It produces a dark background around which the observer mentally reaches toward the light houses in the distance. This principle of framing a picture may be used endlessly. Often nature helps out with dark frames for the foreground. All you have to do is to look for them. Fig. 6 is an example. The trees in front help to create the feeling of space between them and the water, the far shore and the sky. The same method has been applied in Fig. 7. Here the tone values of the dark fountain and tree against the mission church produce the framing effect and create the feeling of distance. Fig. 8 was taken at sunset. A sunset scene alone is often sufficient for a good picture showing depth, as the light is in the distance and the clouds and foreground are much darker. But in this case, an extra dark foreground was built up by placing the camera very low and by silhouetting the grass and the child against the sunset. Exposure was made for the sky and not for the dark foreground, because an over-exposure might block the fine tones in the sky and render the foreground too light.



Map-Shaped Photos for Unusual Travel Album



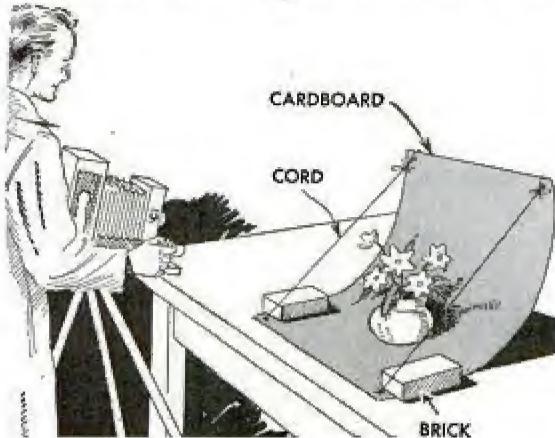
ILLINOIS



WISCONSIN

An album of photos taken in various states or countries takes on a realistic touch when a representative scenic photo in each state is printed through a black paper mask that has been cut to the outline of the state's borders. Choosing a view that not only suits the region it represents but also a composition to fit the particular outline adds interest to both travel and photography. The lower photo, for example, follows the outline of Wisconsin and shows a scene at one of the many lakes for which the state is famous. The stream, woodland and pasture of the upper photo are typical of Illinois, and their composition is excellent when fitted into the boundary of the state. A number of these photo maps could be assembled to form a photo-atlas, and they can be used in other ways also.—Emil Pearson, Redgranite, Wis.

Curved Background Eliminates Horizon Line in Photos



You can provide unbroken backgrounds for your still life and other table-top photographs by bending a single sheet of cardboard to serve as both table surface and backdrop. Two lengths of cord will hold the board to the curve desired and a couple of bricks may be used to weight it down. This setup eliminates the horizon line resulting when two boards are placed at right angles to each other, which is often disturbing to the eye. Common poster board is ideal for the purpose. It is available in a selection of colors which will appear as different shades of gray in black-and-white photography.

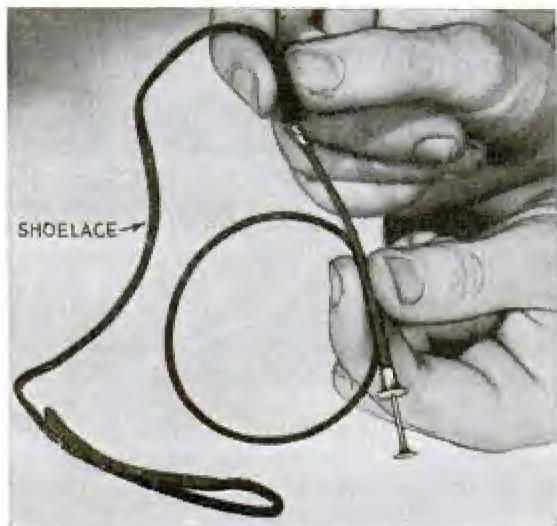
Eraser Buffs Wax Coat on Prints To Improve Their Appearance



Wrapped with a clean cloth, a blackboard eraser makes a good buffer for polishing waxed prints, since it does not scratch the surface. Waxing matte or semimatte prints with a thin film of automobile or furniture wax paste removes the dust and cleans the surface, and buffing gives the print a rich appearance with added contrast.

Shoe Lace Repairs Cable Release

When the cloth cover on a cable release becomes worn, it can be replaced with a small tubular shoe lace. Remove the old covering carefully, after unscrewing the knurled collars at each end. Then slip the

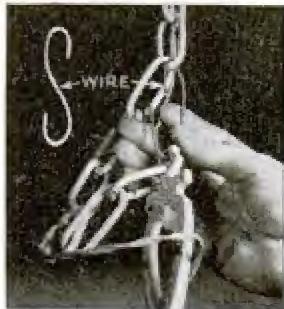


lace on and anchor it at each end with a little shellac, after it has been stretched tight and cut off to the proper length. Screwing the collars back in place completes the job. Care must be taken that no shellac gets inside where the cable slides.

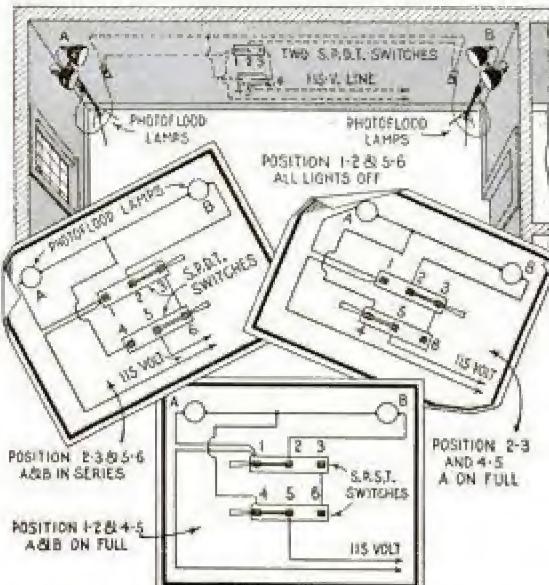
—A. L. Mills, Chicago.

Hook Raises Low Light Fixture Out of Photographer's Way

Low-hanging chandeliers are often a problem to photographers in taking indoor shots. A short length of stiff wire bent to an S-shape as shown, and carried among the other accessories will be handy to loop over as many rings of the chandelier as necessary to raise it to the proper height where it will be out of the way.



Control for Photoflood Lamps



While experimenting recently with a series-parallel control for photoflood lamps, I discovered that greater control of the lights could be had by using two single-pole double-throw switches than is possible with the usual double-pole double-throw switch. With the hookup shown, lamps may be burned individually or together at full brilliance, or they can be connected in parallel. Any number of lamps in multiples of two may be used, up to the capacity of the equipment and the source of the current supply.—Bertram P. Hathaway, Somerset Centre, Mass.



SHOP NOTES



FRESH paint not only protects your power tools against rust, but also improves their appearance, Figs. 1 and 2, as well as the general appearance of your shop. All tools should be the same color. Machine-tool gray is the most popular color, but if you like blue, buff or green, go right ahead. Avoid strong colors—a whole shop full of bright red tools gets to be very tiresome.

First consideration should be given to the matter of paint. If you have a spray gun, lacquer is the logical choice, but if you use a paintbrush, you will get good results and fast drying with any of the popular 4-hour synthetics. Paint will not adhere to a dirty surface, so step number one on the schedule, Fig. 7, calls for a thorough cleaning with soap and water. Follow this with a warm-water rinse and allow to dry. Sanding comes next, Fig. 4, and can be a little or a lot depending on the existing finish. Use aluminum-oxide paper, dry. No. 1/0 is a good starting grit and should be

Above, using a backing block of felt or cork to build a level surface when sanding. Below, masking tape or compound will protect polished parts





LACQUER PUTTY IS USED TO FILL DEPRESSIONS

followed by 3/0 for finish. Blow or dust the surface clean and wipe with a soft cloth moistened with alcohol. Right here you may find that the existing finish is in fairly good shape, permitting the direct application of top coats to finish the job. However, if you want a smooth, slick job, the next step is to apply a full wet coat of primer-surfacer. The material can be obtained with either a lacquer or synthetic base, and in a variety of colors. Primer-surfacer is almost pastelike in the can and is still quite heavy after reducing (follow the directions on can). However, it sprays smoothly with even light-duty guns. Even with the remarkable "build" of the primer-surfacer, you probably will find a few low spots or holes in the surface being finished. Fill them with lacquer putty. Use this product as it comes in the container, applying and smoothing with a putty knife, Fig. 6.

The combined primer-surfacer and putty coat is now ready for sanding. Use wet-or-dry paper with water as a lubricant. Start with 3/0 grit and finish off with 5/0 or 6/0 (180 or 220-grit). Clean off the slush with a soft rag, and then decide whether it is smooth enough for top coats or whether it needs another coat of primer-surfacer. If the machine is a lathe or other tool apt to come in contact with oil, be satisfied with nothing less than a perfectly smooth surface. As many as five coats of surfacer may be needed to smooth up a pebbly or pitted cast-iron surface, sanding each coat until the bare metal shows in the high spots. This is not hard work since the surfacer sands easily and does not clog the paper. If several coats of surfacer are required, it is a good idea to use two different colors.



⑦ FOLLOW THIS SCHEDULE

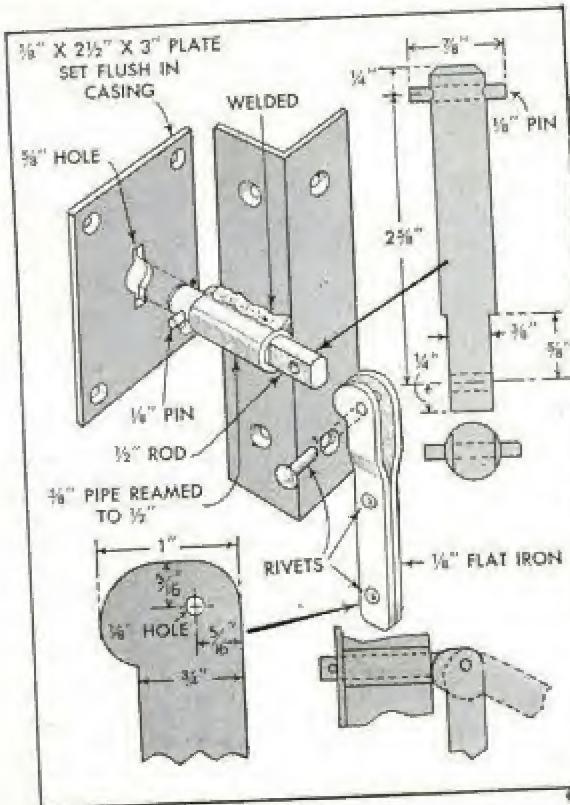
- 1—Wash with soap and water or household cleanser. Rinse clean and dry.
- 2—Sand. Use 1/0 for roughing; 3/0 for finish. Wipe clean with alcohol rag.
- 3—Apply full wet coat of primer-surfacer. Allow 30 minutes dry for lacquer-type material; 1 to 2 hours for synthetic.
- 4—Sand lightly with 3/0 wet-or-dry paper with water as lubricant.
- 5—Fill holes or low spots with lacquer putty. Allow 1 hour or more drying time, depending on depth of coating.
- 6—Wet sand with 3/0 wet-or-dry paper backed with felt block. Wipe clean with soft lintless rag. Inspect. If surface is not smooth, repeat operations 3, 4 and 5.
- 7—Apply one or more coats of lacquer, enamel or synthetic. Use same type of finishing material throughout—never apply lacquer top coat over synthetic base.
- 8—if more than one finish coat is applied, scuff-sand between coats with 6/0 paper, dry.
- 9—if desired, finished surface can be rubbed down with any type of rubbing compound. Many workers use a sprayed-on coat of clear lacquer thinner as a means of obtaining a smooth surface with uniform gloss.

By this method, low spots in the surface are detected instantly. Partial coats directed at a particularly bad spot can be applied and are easily feathered out by sanding. Always use a backing block when sanding; hand backing is useless for building a level surface.

Before applying the finish paint, make certain that there are no breaks to bare metal in the primer-surfacer coat. With a good foundation, one coat of lacquer will do for the finish. If a second coat of lacquer is to be applied, scuff-sand the first coat with 5/0 paper, wet or dry. If you are using synthetic, the first coat should be sanded thoroughly since this product does not "melt" and combine with succeeding coats.

Most tools will require a certain amount of masking if painted with a spray gun, Figs. 3 and 5. The product commonly used for this is masking tape, although old newspapers will do in some places. Large areas of polished metal, such as tables, can be protected by masking compound if desired. However, it is usually quite easy to protect these surfaces by proper manipulation of the gun. Best results are obtained by partially dismantling the tool, removing bright metal where possible, and breaking the paint job into several separate pieces.

Unusual Cam Latch Holds Sliding Door Securely

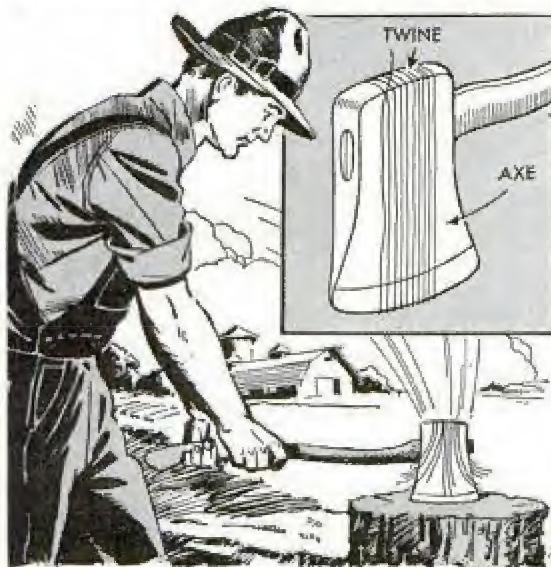


The problem of locking a sliding door and at the same time holding it snugly against the casing to exclude cold air is solved with this cam latch. As shown in the detail, it is mounted on the edge of the door and engages a latch plate on the casing. Pushing the pinned end of the latch bolt into a double-winged keyhole in the plate and then turning the bolt secures the

latch. Lowering the latch handle causes the cammed end of the latter to press against the bolt housing, which is a short piece of pipe, and thus force the door tightly against the frame. The latch can be made from a few scrap parts.

—A. J. Van Dusen, Eldridge, N. Y.

Twine to Make Sack Ties Measured and Cut With an Ax



The next time you need a number of sack ties, try cutting them with an ax as shown. This method will assure uniform length and save time. Just wrap twine or string used around an ax and then drive the blade into a block of wood to cut the string.

Mousetrap Serves as Rain Signal

When it rains during the night, you will be warned to close the window if you have prepared an ordinary mousetrap by holding the spring open with a strip of newspaper, the loose ends of which are fastened to the trap by cellulose tape, gummed paper or staples. If any rain hits it, the newspaper will soften, allowing the trap to close with a bang. To produce a louder sound, turn a small pan upside down and place the trap on it.

—J. A. Swank, Dayton, Ohio.

Chalk-Mark Pattern on Anvil Aids in Shaping Work



In order to bend a number of iron rods to an accurate shape without stopping to compare them with a pattern, one blacksmith chalked a pattern on the face of the anvil. Checking the work then was just a matter of comparing it with the mark.

Sliding Doors Are Closed Easily By Rope and Pulleys

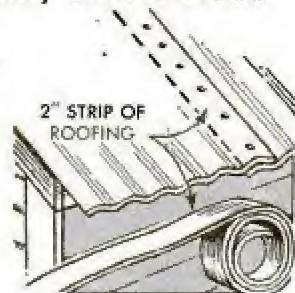
To close a heavy sliding door on his barn with little labor and inconvenience, a farmer uses the rope-and-pulley arrangement shown. The rope, passing through the pulleys, is attached to the door and corner of the barn, and one of the pulleys also is attached to the barn corner, the other being fastened to a length of pipe to serve as a handle. Thus, by pulling down



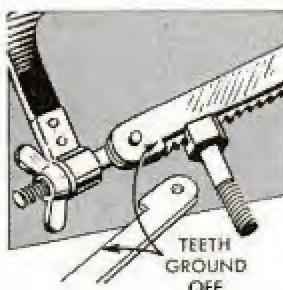
on the handle the door is closed. The pulley arrangement reduces the pull by at least one-half. Also the attachment of the rope at the top of the door brings the pull in line with the door rollers so that there is no friction from binding, which often happens when the door is closed by pulling on the regular handle.

Repairing Leaky Metal Roof

If a corrugated metal roof leaks at the joints, sometimes it can be repaired by applying strips of asphalt roofing paper to the joints between the metal sheets as indicated. Make the strips about 2 in. wide. This repair is especially helpful if high winds have a tendency to drive rain between the sheets at the joint.



Depth Gage on Hack Saw Blade For Slotting Screws



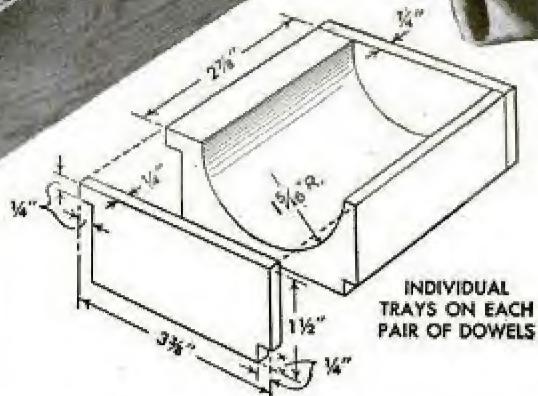
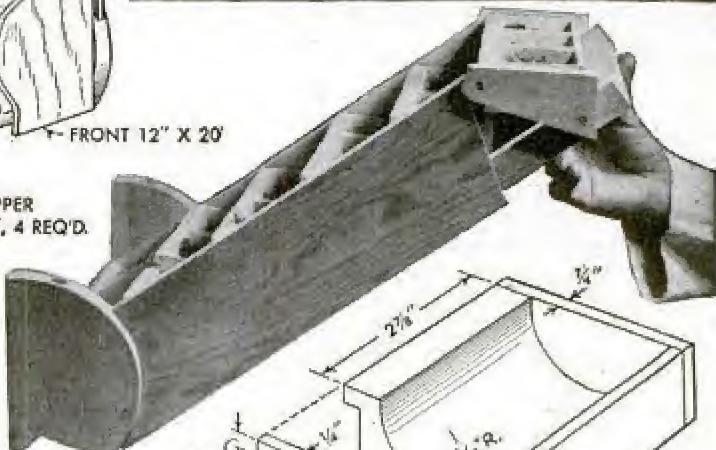
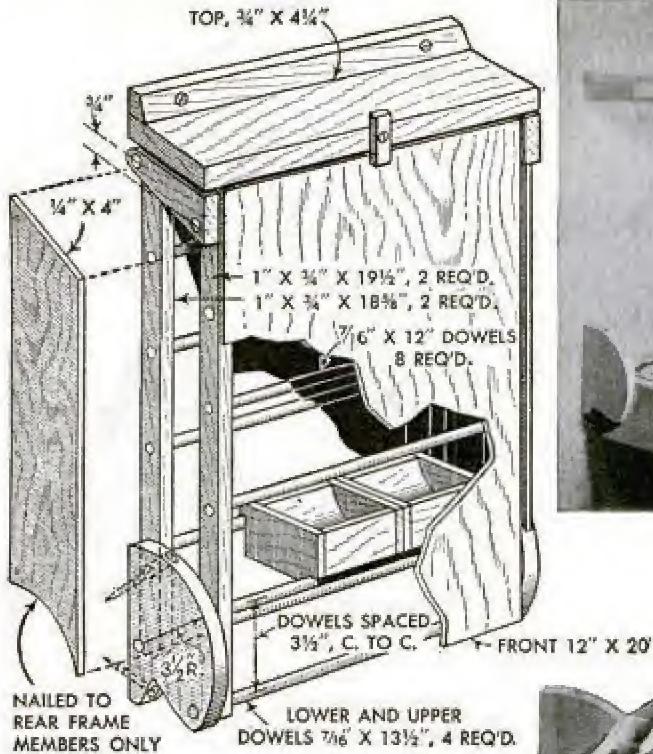
Having a number of screw heads to slot with a hack saw, one workman used an old worn-out blade as a depth gage to speed up the work. The teeth of the old blade were ground back a distance equal to the desired depth of the slots, after which it was put in the saw frame beside the regular blade as indicated. In this position, the good blade could cut into the screw heads only to a depth permitted by the altered blade.

Commutator Trued Accurately With the Aid of Prussian Blue

When the commutator of an auto generator or starting motor is worn out of round, or has grooves cut into its surface by brush friction, it is good practice to turn it down to a slightly smaller diameter, but with its original cylindrical shape. In doing this work, make it a point to remove no more copper than is absolutely necessary. To determine when to stop cutting, give the commutator a coating of Prussian blue. Watch during the turning operation and when the blue has disappeared, permit the tool to finish its lateral travel and then stop the cutting.

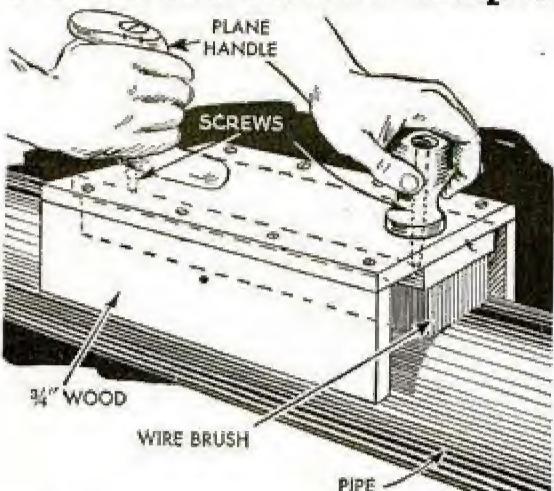
—W. C. Wilhite, Carlinville, Ill.

Small-Parts Cabinet Folds Flat Against the Wall



Folding against a wall out of the way when not in use, this cabinet takes little space and has small removable trays that can be taken right to the job at hand. The cabinet is made easily from small scraps of pine, plywood and dowels, and the rounded tray bottoms make it easy to pick out the contents. Dimensions given in the drawings are merely suggestions, as the cabinet may be made larger or smaller to fit available space or needs. The cabinet can be varnished or painted if desired.

Guides and Handle Simplify Use of Pipe-Cleaning Brush



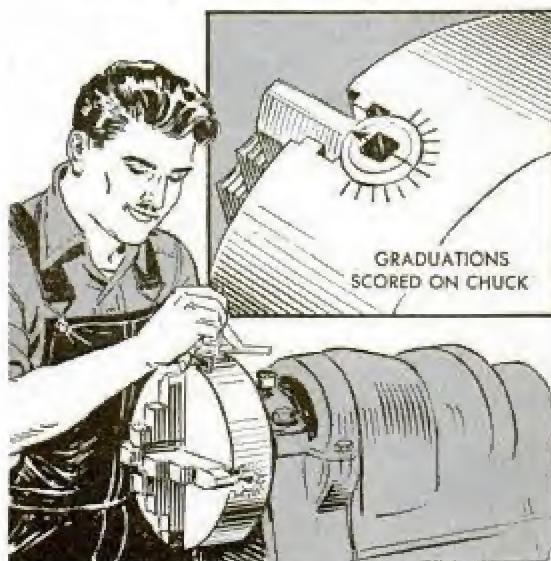
Given a job of cleaning paint and rust from used pipe, one workman screwed sides to a large wire brush so that he could use it without it slipping off the work. A handle and knob from an old plane made operation of the brush easy.

—James Vick, Church Road, Va.

New Paints for Window Lettering

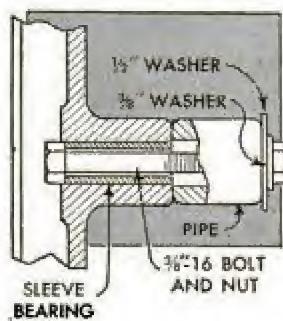
For temporary window lettering which will not wash off in even a heavy rain, try the new plastic-resin type paints. They are inexpensive, easy to use and come in a variety of colors. To remove, use a fairly strong cleaner and a scrub brush.—R. Verbrugghe, Grosse Pointe Park, Mich.

Scale Around Chuck Screw Hole Aids in Centering Work



To aid in quickly centering work in a chuck, one machinist scored graduations on the chuck surface around the jaw screw openings, and then made an index mark or line across the exact center of each screw. With this arrangement, the work is first chucked as accurately as possible by reference to the concentric circles on the face of the chuck, after which it is brought to a true center by adjusting each screw so that all index marks point to identical lines on the scales. To graduate the chuck, first chuck a piece of true work accurately. It is important that this be done with absolute accuracy. Then score a preliminary line across the edge of each screw, extending it about $\frac{1}{4}$ in. onto the chuck surface. This line should pass exactly through the centerline of the screw, and should be parallel with the lathe centerline. Now, the screws can be removed to deepen the scores. After replacing the screws, as many lines as desired can be scored on the chuck surface at the sides of the first line. Care must be taken to see that the lines are of equal spacing at all of the screws.

Sleeve-Bearing Puller Made Easily



If you have some sleeve bearings to remove and there is no suitable puller at hand, the job can be done with a bolt. Grind down the bolt head to the same diameter as the outside di-

ameter of the bearing. Then insert the bolt into the bearing, and over the projecting threaded end slip a piece of pipe having a length at least equal to that of the bearing. Now, place a large and small washer over the bolt as shown and turn on the nut. Driving on the nut with a wrench will pull the bearing.

—Ralph H. Preston, Roseland, N. J.

Stencil Attached to Mimeograph Without Wrinkling It

The difficult job of putting a stencil on a mimeograph machine without wrinkling it can be made much easier by using a trouser hanger as shown. First, attach the reinforced end of the stencil on the machine and then grip the other end with the hanger. This will keep the stencil smooth and straight as it is placed on the cylinder.—A. H. Waychoff, Phoenix, Ariz.



Curbstone Flagstaff Anchors Sign In Place on Sidewalk

One merchant, who always displayed the flag on the sidewalk in front of his store, utilized the staff to keep a sign from being tipped over. To do this, U-shaped metal straps were riveted to the sign to provide loops through which the flagstaff was inserted as indicated.

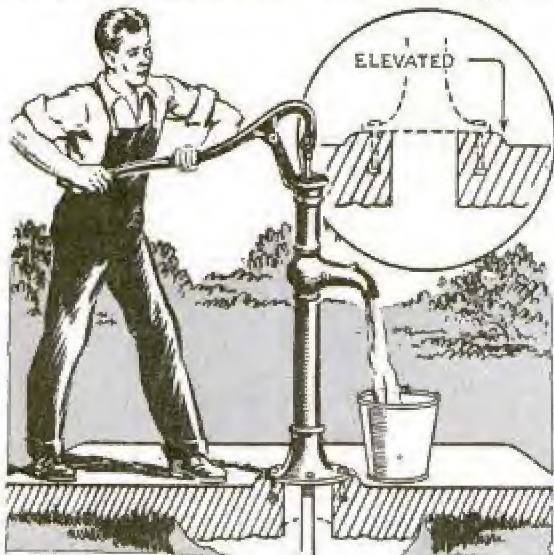


Piece of Hacksaw Blade Spaces Shading Lines

Shading lines can be drawn rapidly with this simple device, which assures that they will be uniformly spaced. The device is made from two triangles, one being larger than the other. A piece of hacksaw blade is riveted near the longer side of the large triangle, and a pointed block of celluloid is cemented to the smaller triangle to engage the saw teeth when the two triangles are used as shown. Now, by moving the small triangle along progressively to engage the saw teeth as the shading lines are drawn, all lines will be spaced uniformly.



Well Platform With High Center Excludes Waste Water



To keep all surface water from running into his well, including waste water from the pump spout or that spilled from buckets and other containers while filling them at the pump, one farmer made a concrete platform and elevated the center around the pipe opening as indicated. When the top of the well is wide, it is a good idea to reinforce the concrete with rods or other suitable pieces of metal. Lengths of woven wire fencing are good for this purpose when not too rusty. If the platform is to be practically airtight, a vent should be provided. This can be a short piece of large diameter pipe reaching through the platform and projecting a few inches above it. Screen wire over the upper end of the vent will keep out insects and particles of foreign matter. The wire is best attached by soldering it to the pipe.

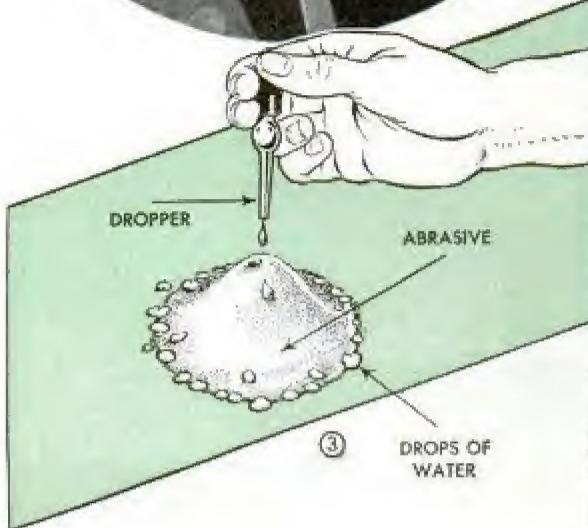
Repairman Carries His Planks and Stepladder Under Truck Body

As our business consists of general building repairing, it usually is necessary to take a plank and stepladder to most of our jobs. To be sure that these would always be at hand, and also to leave more room on the truck for other tools and materials, the ladder and planks were carried under the truck body as indicated.

—Philip Maskeill, Astoria, N. Y.

Avoid damage from the end of a disconnected auto starting motor wire by slipping a short length of garden hose over it.





Metal POLISHING

By H. J. Chamberland

METAL polishing is an abrasive operation which imparts a predetermined grade of surface finish for appearance rather than size tolerance. The purpose may be a complete operation to obtain a final finish or it may be a preparatory step for nickel or chromium plating. Metal polishing is closely related to grinding in that both operations require manufactured abrasives as a cutting agent.

Polishing wheels, such as the one in Fig. 5 where an airplane connecting rod is being finished, consist of wheels built up from layers of felt, canvas, sheepskin, walrus or other kind of leather either glued or sewed together. Unlike grinding wheels, polishing wheels are flexible and are classified as hard, medium and soft, depending on the degree of flexibility which is determined by the material of which they consist and the method used in binding the layers together. Polishing wheels are available in a semi-finished stage only and must be given their abrasive properties in the shop where used. The application of the abrasive to the periphery of the wheel is

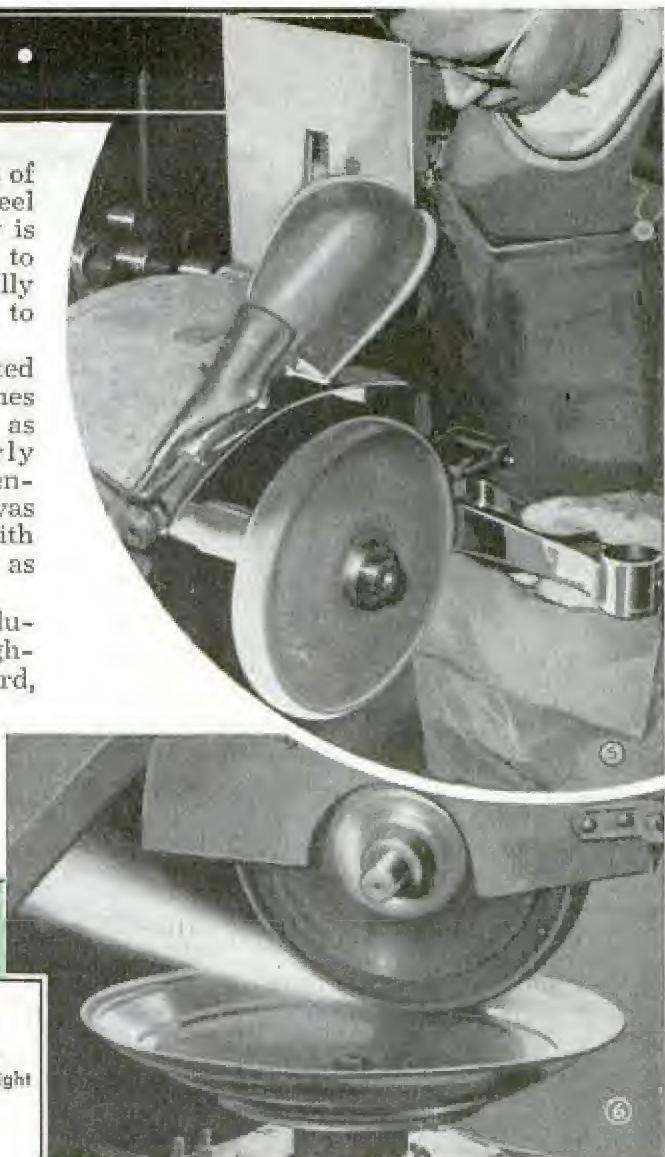
④ POLISHING OPERATIONS				
Part or Material	First	Second	Third	Fourth
Aluminum Castings	60-80	120-180	Buff	
Aluminum Sheets	120	180	Buff	
Bond-Saw Steel and Similar Stock	60-80	120-150		
Brass Castings	60-80 With Oil	150-180 With Oil		
Brass Sheets	180-220	Buff		
Hammer Heads	46-60	100-120		
Knives—Table and Steel Blades	80-90	120-150		
Monel-Metal Castings	80	120	150	
Monel-Metal Sheets	180	180 With Oil	220 With Oil	Buff
Plow Discs	30-46	70-90		
Shovels	36-46	120		
Shears Tinsmith	46	60	120-150	180
Stainless Steel Mirror Finish	60-80	100-120	150 With Oil	220 With Oil
Stainless Steel Commercial Finish	80	100	120 With Oil	150
Wrenches	30-46	80	120 With Oil	
Lenses—Eye Glass and Telescopic	60-80	180-220	Optical Flour	Rouge

WHEELS . . .

called "setting-up" and the thickness of this application is referred to as "wheel head." The abrasive grain generally is aluminum oxide and varies in size to meet finish requirements. A specially selected and prepared glue is used to hold the grain in the wheels.

Most polishing wheels are mounted on pedestals, but there are portable ones also which are carried to the job as shown in Fig. 1. Small, irregularly shaped parts are polished most conveniently on an endless leather or canvas belt as in Fig. 2, which is coated with abrasive grains in the same manner as polishing wheels.

Selection of abrasive grain: The aluminum-oxide grain must be of the highest quality, must be extremely hard, tough and uniform in structure, size and shape. All these properties are important because there are various grades of finishes, obtained by as many as five consecutive operations. Often a different shape of grain, exclusive of size, is required for each



Photos by courtesy of Norton Co.

(7) PROPORTIONS OF GLUE AND WATER FOR VARIOUS GRADES OF ABRASIVES

Size of grain Aluminum oxide	Glue % by weight	Water % by weight
24—36	50	50
46—54	45	55
60—70	40	60
80—90	35	65
100—120	33	67
150—180	30	70
220—240	25	75

polishing stage from rough to final finish. When selecting the type of grain, its rate of capillarity or how fast it will absorb water is an important consideration. In making the capillarity test, water is applied drop by drop to a pile of abrasive grains as shown in Fig. 3. If it rolls off, the grains are low in capillarity and a wheel set up with such grains will wear down quickly due to uneven spread of the glue. If the grain absorbs water readily, it will permit the glue to spread uniformly, resulting in durable fast-cutting wheels. Standard sizes of grain vary from coarse to fine and are known by numbers such as 24, 46, 70,

100 and up to 240. From 240 to 600 the grain is fine, extra-fine and super-fine flour. Fig. 4 gives a table of general recommendations regarding grain size for polishing operations on various materials and jobs.

Selecting and preparing glue: For maximum results it is advisable to use a good grade of animal hide glue as an adhesive. Bone, fish or cold glues are not suitable for this purpose. The glue and water should be mixed by weight accurately to eliminate any guesswork. It should be freshly made and used within 3 hrs. Fig. 7 gives size of grain and corresponding percentage of glue and water to use. The glue is soaked in cold water for some time to make it dissolve more readily when heated. Ground glue should soak from 1 to 2 hrs., flake glue from 6 to 8 hrs. and cake glue from 12 to 14 hrs. To melt the glue, a water-jacketed glue pot is recommended. The correct tem-



perature of the mixture, abrasive and room, as will be explained later, is highly important. Therefore, be sure to use a thermometer in the glue pot whether or not the heater has a thermostatic control.

Using correct type of wheel: For best results, the use of the correct type of wheel is just as important as the proper abrasive grain. The sewed canvas wheel is used generally for severe and not too important polishing operations when the grain size ranges from 24 to 46.

The disk canvas wheel is also a heavy-duty type. Each disk comprising the wheel is glued on both sides to stiffen the canvas, the glue extending close to the edge of the wheel when a hard face or head is desired. Such a wheel can be used to polish plow disks as in Fig. 6.

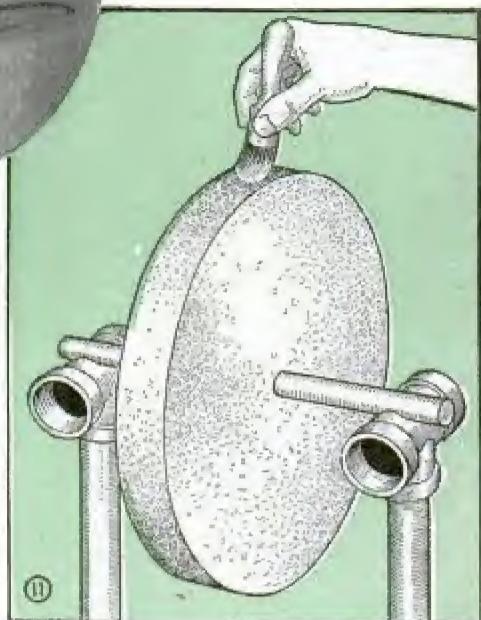
The compressed wheel is made of canvas or leather similarly glued on the sides. There are three grades known as hard, medium and soft,

depending on how close to the edge of the wheel the layers are glued together. This wheel is used extensively to polish cutlery, and small tools such as auger bits, Fig. 8, button dies or similar parts with parallel sides. The advantage of this type wheel is that its periphery can be shaped to that of the surface to be polished. Any size grain can be used with the compressed wheel.

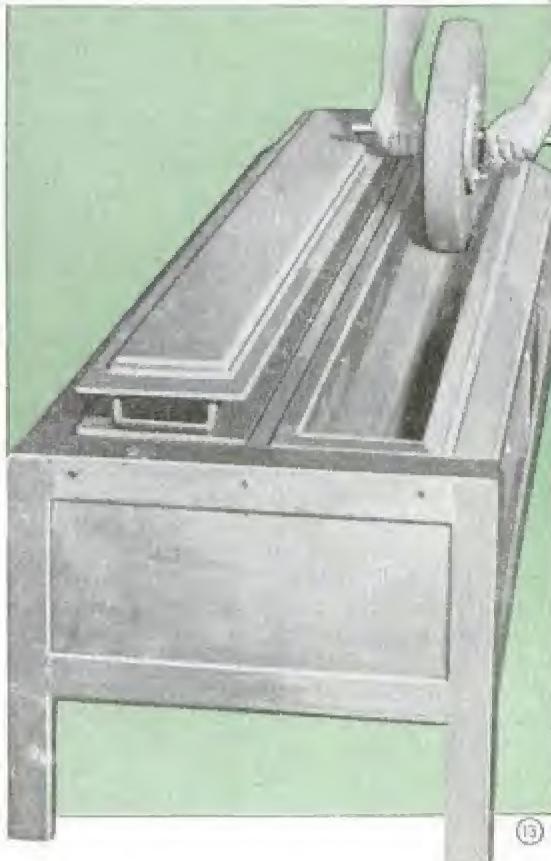
The felt wheel usually is set up with grain size 150 and finer. It is extensively used for producing a high finish on steel and iron or a somewhat medium finish on brass and aluminum castings. The sewed buff wheel is an all-purpose type and, as it is soft and flexible, it gives an excellent finish on brass, aluminum and sheet steel.

The sheepskin leather wheel is very flexible on brass and aluminum alloys and small stainless steel parts made of sheet stock. The walrus leather wheel is for finishing and is used to polish jewelry, instruments and small gun parts. Wooden polishing wheels are still used in many small plants and are most economical for experimental and home-workshop use.

Setting-up polishing wheels: Before attempting to set up a polishing wheel, make sure that the room is free from drafts and that the temperature is between 70 and 80 degrees F. to prevent jelling of the glue. If the abrasive and wheel are of



the same temperature, the glue should be heated to 160 degrees F. While small wheels may be held by hand while applying the glue as in Fig. 9, larger wheels should be mounted as shown in Fig. 11. After applying the glue, the wheel is rolled in a trough containing a sufficient quantity of abrasive grain as in Figs. 10 and 13, which illustrate troughs for small and large wheels respectively. Rolling should proceed evenly so the wheel will pick up all grains it can hold, and as quickly as possible for maximum adhesive results. In setting up wheels, some experts prefer preheating the grain and the cloth wheels to 100 or 120 degrees F., and then applying the glue at 140 degrees, the idea being that the grain will penetrate the glue more readily, and as a



result produce a superior polishing wheel.

Polishing belts are set up by spreading, with a trowel, knife or brush, a suitable paste made by adding preheated abrasive grains to a heated glue solution. The mixture should contain the maximum amount of grains for a workable consistency. When coarse grains are used for severe polishing jobs, they should be pressed in with a roller. In this case it is advisable to give the belt a sizing coat consisting of water, 8 parts and glue, 1 part. Frequently, finer

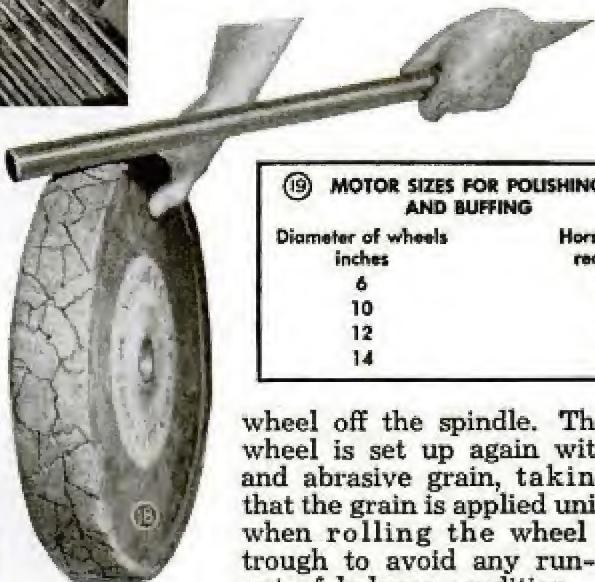
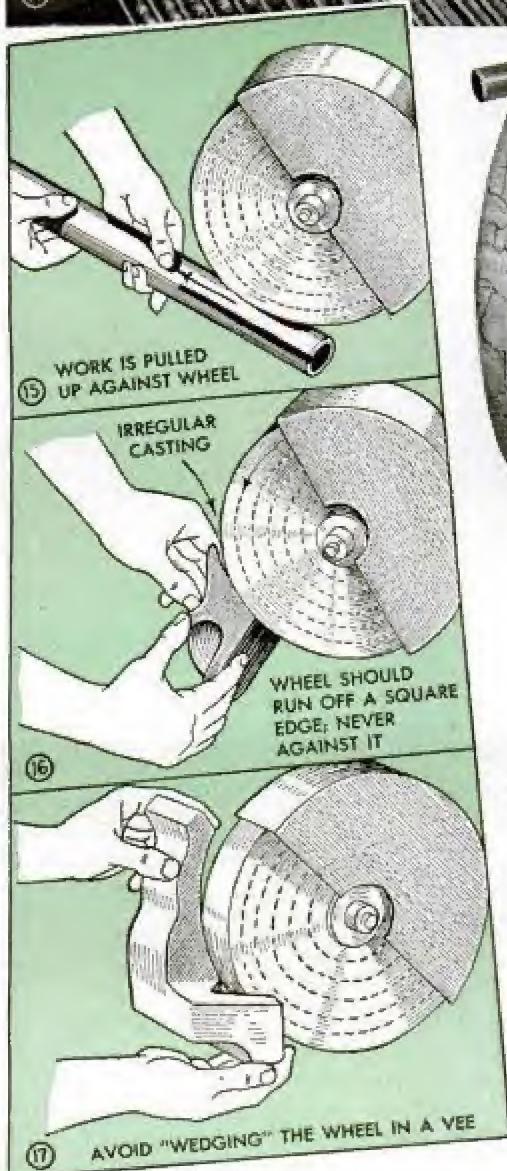


abrasive grains are sprinkled on the belt after painting it with glue. Fig. 12 shows what is known as the centerless method of cylindrical polishing, a compressed wheel and a wide leather belt being used for the purpose. The wheel rotates the shaft by friction at the required speed and the belt, operating at a much higher surface speed, does the polishing.

Drying glue-coated wheels: Animal-hide glue is known to take on or give off moisture, depending on the humidity. This glue is strongest when it contains 10 to 12 percent moisture and therefore the wheels should be dried. Large industrial plants have air-conditioned drying rooms for this purpose. The correct drying temperature should be 85 degrees F., and the relative humidity should be 50 percent. Under such conditions one-coat wheels will dry in 24 hrs. and two-coat wheels in 48 hrs. Factors that govern drying time are thickness of wheel head, strength of the glue and size of the grain. Generally, the thicker the wheel head, which indicates the number of coats, the longer will be the drying time required. One method of determining whether a wheel head is sufficiently dry, is to hit it with a round steel bar held at about 45 degrees as shown in Fig. 18, and observe how readily cracks appear. This should be done around the wheel entirely and then repeated at the opposite angle to form a series of X-cracks. Cracking the wheel gives a springy cutting edge, resulting in a combined wiping and polishing



18



19 MOTOR SIZES FOR POLISHING AND BUFFING

Diameter of wheels inches	Horsepower required
6	1/4
10	1
12	2
14	3

action. Final step is to dress the edge with a piece of broken grinding wheel.

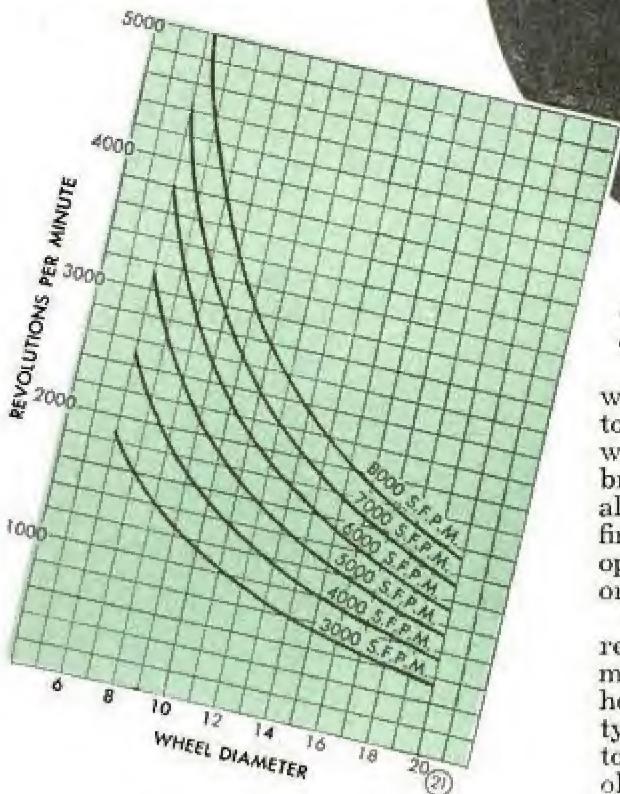
Balanced wheels important: Material for polishing wheels is machine-cut and the hole is made sufficiently large for the use of a bushing, otherwise the wheels would lack the necessary support when placed on a spindle. The hole in the bushing should provide for a good fit on the spindle to keep the wheel in proper balance. Polishing wheels, like grinding wheels, require a collar on each side, the diameter of the collar depending on the diameter and type of wheel.

Once a polishing wheel is worn, the old grain and glue must be removed with an abrasive stick and the wheel should be trued, which can be done with the end of an old file, before taking the

wheel off the spindle. Then the wheel is set up again with glue and abrasive grain, taking care that the grain is applied uniformly when rolling the wheel in the trough to avoid any run-out or out-of-balance condition.

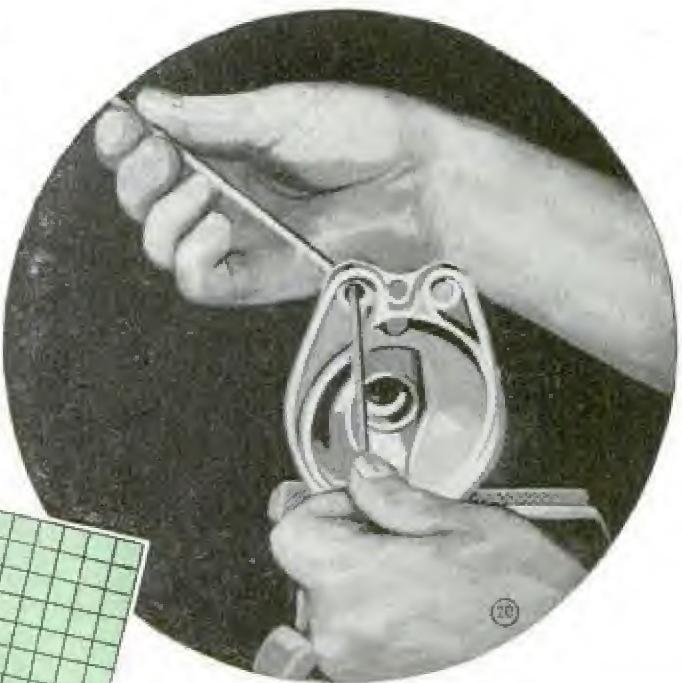
Wheel speed: Before operating a wheel, the operator should check up pulley relation and adjust the guard. Assuming that the spindle bearings are in first-class condition and that the wheel is in perfect balance, the next step is to determine its vibration points. If a good job of setting-up has been done, the grains being strongly bonded, the wheel can be operated at a higher speed than is possible with a weaker wheel head. With very good equipment, wheels should be operated at about 7500 surface feet per minute (s.f.p.m.) for best polishing results. However, for general economy, some polishers claim that best all-around polishing speed is around 5000 s.f.p.m. as the wheels wear more rapidly as the speed increases, necessitating more frequent resetting, and the increase in cutting action at higher speeds does not seem to compensate for excessive wheel wear. Fig. 21 shows a graph giving s.f.p.m. of various size wheels at different speeds, while Fig. 19 gives horsepower requirements to operate wheels of various sizes satisfactorily.

Safety precautions and helpful hints: When polishing is done with a small bench type of grinder, certain safety precautions should be observed. After checking to see that the guard is set to clear the work, make sure that the wheel is tight on the shaft and runs true. A polishing wheel should always rotate in the same direction. An arrow painted on one side will serve as a reminder when the wheel is put on a spindle. Work is pulled upward against a wheel as



shown in Fig. 15. With irregular castings, the wheel should run off a square edge as in Fig. 16, but never against a square edge or the work may be pulled from the hands and thrown with dangerous force. The same risk is incurred when the wheel is "wedged" in a narrow portion of the work as shown in Fig. 17.

Where several polishing operations are to be done in sequence, wheels of the same diameter but having different abrasive coatings may be ganged on a single spindle as shown in Fig. 14. This arrangement is followed in large shops where convenience and the saving of time help to speed up production. When hard-to-get-in places have to be polished, narrow strips of twisted, tube-like abrasive cloth can be used by hand as in Fig. 20, or on a small mandrel chucked in an electric drill or grinder.



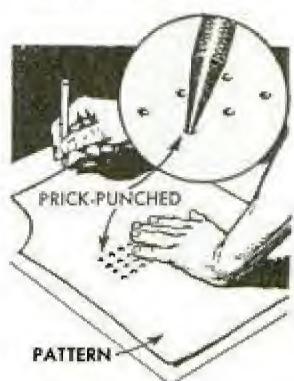
Conelike polishing points of similar spiral design also are available.

Greasing the wheels with oil or tallow will prevent loading. This is recommended to buff or finish aluminum sheets and all wheels required to polish aluminum and brass castings. Buffing operations are usually performed by skilled operators. Satin finishes are obtained on brass by a first operation called "cutting down" and a coloring agent is used for second buffering.

When a large quantity of identical irregularly shaped parts require polishing, much time is saved by forming the wheel head or face accordingly. The compressed type of wheel may be shaped quite readily to the required outline with the end of an old file ground with a clearance and corners slightly rounded. The wheel will require a certain amount of dressing after setting up to fit the surface to be polished.

Metal Pattern Is Prick-Punched To Hold It Easily in Place

To facilitate holding a small metal pattern on work to be marked, one worker indents a section of the pattern with a prick-punch to make several slight, sharp elevations. The pattern may thus be held with the fingertips.



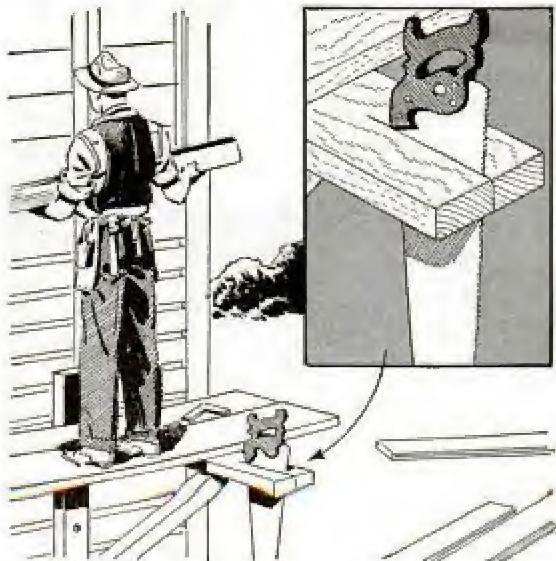
Wooden Scoop Handles Chicks Safely and Rapidly



The slow job of transferring baby chicks from the brooder trays to the shipping cases led one hatchery operator to use a prong-scoop like the one shown. The prongs are small dowels, rounded at the ends and inserted into holes in a wooden handle, the dowels being spaced about 1 in. apart. When lifted with the scoop, the legs of the chicks extend down between the prongs so that they cannot easily jump off the scoop.

Slot in End of Scaffold Bracket Holds Saw Out of the Way

Instead of laying a handsaw down on a scaffold where it may be stepped on or kicked off to endanger persons below, one carpenter slotted the projecting end of one



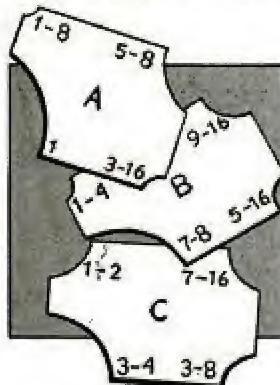
of the scaffold brackets to take the saw when it was not in use. Width of the slot should be a trifle more than the thickness of the saw blade to permit easy insertion.

Paper Layers Keep Stacked Cans From Tipping Over on Shelves

In stores and other places where canned goods are stacked in tiers, they can be kept from tipping over by placing newspapers between each row of cans as indicated. This idea will be found especially handy in self-service stores where patrons may bump against the cans, or where they may be dislodged accidentally when removing one.



Welders' Filet Measuring Gages

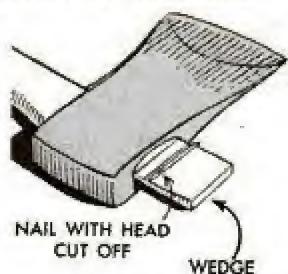


A set of three gages like the ones shown will enable welders to gage filet welds accurately, which, for best results, should be as wide as they are high, and slightly rounding or convex. The gages shown have a full radius cut in them for clearance only,

and the weld should not necessarily fill the full gap except for height and width. To make the gages, use a corrosion resistant metal such as monel or brass about $\frac{1}{16}$ in. thick.—P. M. Wilson, Napa, Calif.

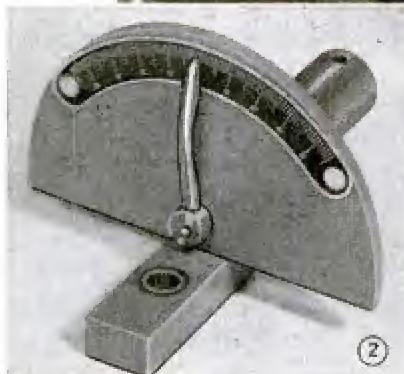
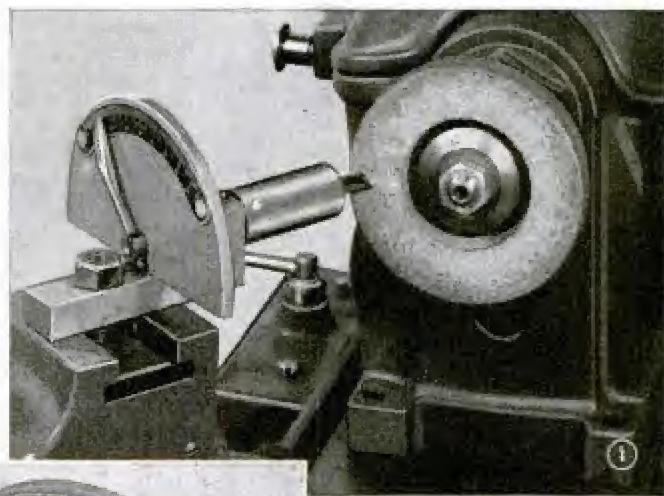
Wedge Locked in Ax Handle

Prepared as shown, a wedge to keep an ax on its handle cannot work out because it is locked in place by a headless nail. The nail is placed in a shallow groove cut across the wedge, which then is driven into the split end of the handle. Any tendency of the wedge to move outward causes the nail to bind tightly between the wedge and handle.—Benj. Nielsen, Aurora, Nebr.

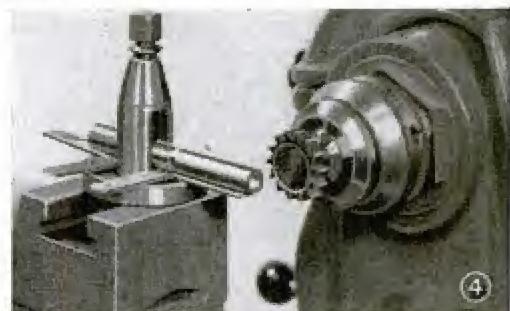
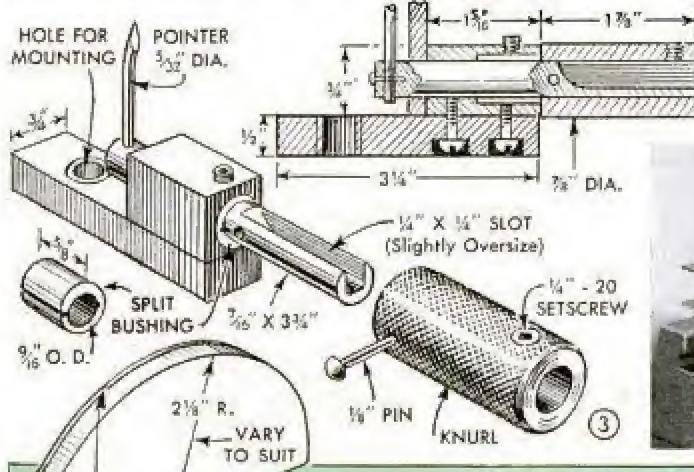


Grinding Angles of Tool Bits Set by Lathe Jig

Mounted on the compound rest of a lathe, this attachment or jig provides a means of setting a tool bit at an accurate angle for grinding. Construction is shown in Fig. 3. The rotating spindle is small enough so that it can be chucked directly in the tool post for cutting the tool-bit slot, Fig. 4. Clamping of the rotating spindle is done by a split bushing to prevent marring from direct contact of the set-screw. The scale, Fig. 2, can be a ten-cent protractor mounted on a plate, which is held in place by a tight fit against the base block. In use, the bit is clamped in the holder and then it is set by means of the protractor scale and the compound scale so that the edge to be ground will be in proper contact with the grinding wheel as in Fig. 1. The preferable grinding wheel is the recessed type, but a plain wheel will do. Wheel speed need not be over 1000 r.p.m. with a



4-in. wheel. Fast cutting is obtained by feeding the bit in with the lathe cross slide, taking off a small bite at a time until the full shape is obtained. Do this carefully so that you do not remove too much metal before you realize it. Angle settings can be obtained from any lathe-bit chart, four of the more common bit shapes being shown in Fig. 5.



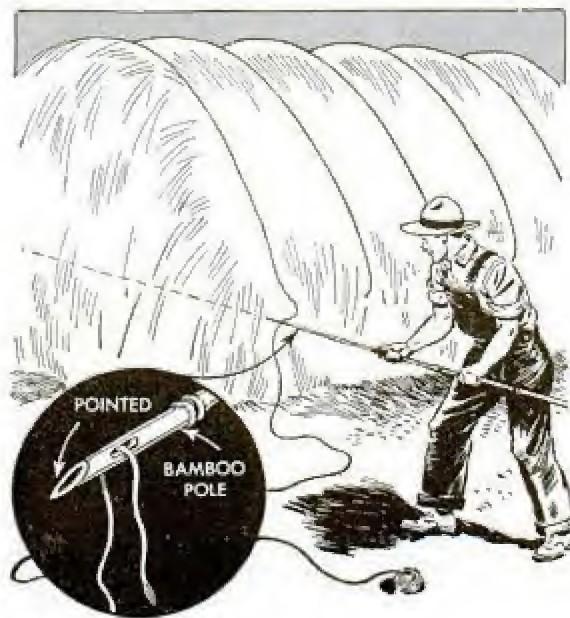
Old Horseshoes Provide Handles For Carrying Shingles



For convenience in carrying bundles of wooden shingles, one carpenter uses discarded horseshoes as handles. These are hooked under the cross straps of the bundles so that one can be carried in each hand. It may be necessary to grind off the corks of the shoes so they can be inserted under the straps easily.

Top "Sewed" on Large Haystack To Avoid Damage by Wind

To save ropes or wires that would be needed to anchor the top of a large haystack against wind damage, one farmer sewed the top in place with binding twine. An eye was drilled through the small end of a long bamboo fishpole which served as a needle for use in stitching the twine

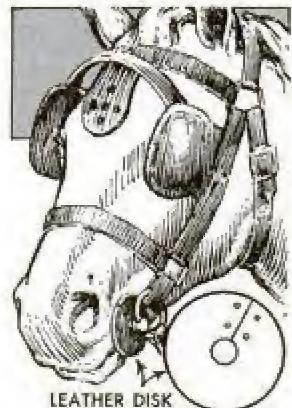


through and over the stack to bind it securely. Each stitch should be tied so that removal of the hay in small quantities will not loosen the remaining ties.

Leather Disks on Bridle Bit Protect Colt's Mouth

When breaking a colt, the bridle bit sometimes makes its mouth sore, and because of the animal's refusal to respond to the reins, the bit often is pulled to one side through its mouth. I find that much of this trouble can be prevented and the colt taught to respond to the reins quicker if a 3-in. leather disk is placed over the bit at each side of the mouth.

—Mike R. Hofer, Rockyford, Alberta, Can.



Wiper and Sanding-Pad Cover Prevent Smudged Drawings



The possibility of accidentally smudging a drawing with graphite dust from a newly sharpened pencil is minimized by one artist who keeps a pencil wiper close at hand, and also covers his pencil sanding pad. These are suspended from his drawing table as indicated. The pencil wiper consists of strips of paper toweling and the cover for the sanding pad is a small paper sack.—Ray Ligocki, Hammond, Ind.

Frozen Truck Fleet Carburetors Thawed With Exhaust Gas

Truck and army motor-fleet operators in cold climates can save many hours of time lost in disassembling and thawing frozen carburetors by the following method: Secure a 10-ft. length of hose, to fit on or into one end of the tailpipe of a car or truck that is running and direct the warm exhaust gas over the frozen carburetor. This will melt the ice and the water can be drawn through by generous use of the choke.

—R. S. Demitz, Fort Benning, Ga.

HOT WAX FINISH

THIS finish differs from conventional wax treatment in that it is applied directly to the bare wood. Best woods to use for this treatment are beech, birch, cherry or maple. Both the work and wax must be kept hot throughout the entire application. Buffing the work after the wax coating has cooled should be done across the grain of the wood to give a filling action, following this treatment by a light buffing with the grain. Colored finishes can be obtained by first staining the work before the wax is applied. Also, excellent effects can be had by using tinted wax, which is obtained by coloring the wax with a small amount of oil color while mixing it.

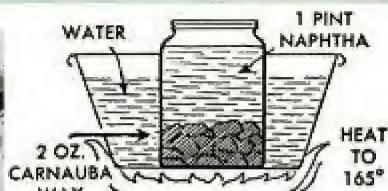
*Ideal
for
Small
Projects*



① Shred the lump of wax. Carnauba wax is by far the best natural wax to use by virtue of its extreme hardness, but beeswax, ceresin, candelilla or even paraffin can be used.



② Add to 2 oz. of shredded wax, 1 pt. of naphtha or turpentine, naphtha preferred. Colored wax can be made by adding a small amount of oil color.



③ (Above) Place the mixture in a pan of water and heat. The wax will dissolve at about 165° F. Use electric fan to blow naphtha fumes out of open window.

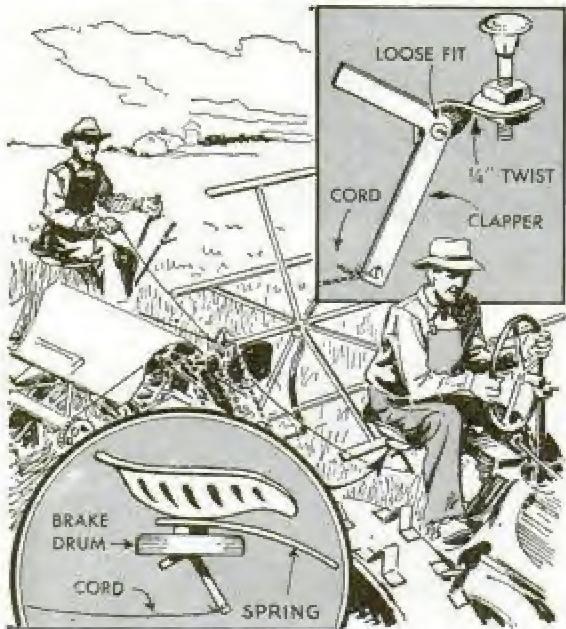


④ Work must be sanded very fine and must be heated to at least 110° before wax is applied. An electric light bulb in cardboard box can be used for heating.



⑤ (Left) Wax must be applied hot, either a freshly made solution or old solution reheated. Temperature should be 150° F. or higher. Wax should be applied quickly and evenly while work is still warm.

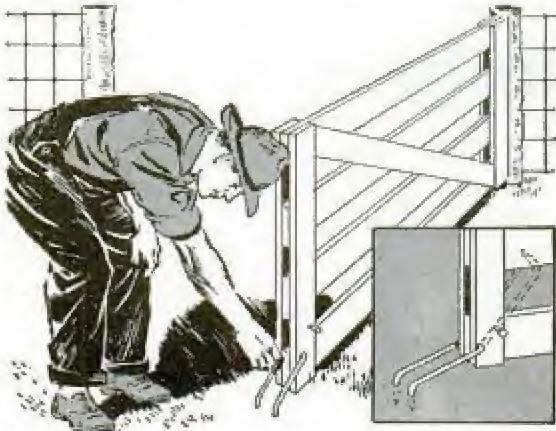
Bell for Rider on Towed Machine To Signal Tractor Driver



When a machine that makes considerable noise, such as a grain binder, is pulled by a tractor it often is difficult for the operator riding on the towed machine to signal the tractor driver. To overcome this trouble, one farmer installed a signal bell under the tractor seat. The bell consisted of an old auto brake drum fitted with a clapper as shown, the long arm being provided with a cord extending to the towed machine so that a pull on the line would ring the bell. If the machines are operated on rough ground where the clapper would swing sufficiently to give false signals, the long arm could be provided with a spring to avoid this trouble.

Simple Catch Engages Ground To Hold Gate Open

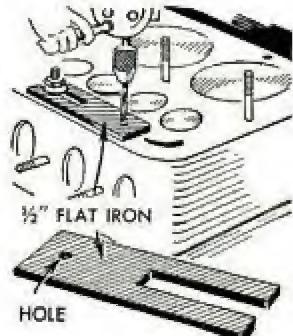
Disliking to use a latch post that would always be in the way to hold open a large



gate, one farmer bored a hole through the end of the gate to take a length of iron rod, which was then bent to the shape shown. This provided a holder that could be dropped down to keep the gate open or raised to rest against a projecting nail.

Broken Studs Drilled From Motor With Aid of Simple Guide

If you are unfortunate enough to twist off a cylinder-head stud bolt and have to drill it out, this guide for the drill bit will help avoid damage to the threads in the motor block. Also, it will enable you to use a larger drill than when the work is done freehand, thus making it easier to remove the metal after the bolt has been drilled. As indicated, the guide is locked under an adjacent stud and adjusted so the guide hole is centered over the broken part of stud to be removed.



Brush Better Than Sifter Can To Apply Insect Powder



Although insect powders for poultry usually are supplied in sifter-top cans, it is difficult to apply the powder properly under the wings of the fowl because the feathers lie so close to the skin. To overcome this, one poultryman employs a discarded soft vegetable brush for the work.

The powder is emptied into an open pan, and the brush, dipped into this, is used to ruffle the feathers and apply the dust.

Weak Blueprints Easier to Read Under Red Cellophane

Placing a sheet of red Cellophane or similar transparent material over improperly printed or faded blueprints will enable you to read them much more easily. The method is particularly useful for reading fine detail. For permanent use, a piece of red Cellophane can be mounted in a wood or cardboard frame.



Radio

A.C.-D.C. Test Oscillator

By R. C. HITCHCOCK

ADJUSTABLE to any frequency in the broadcast band, this simple signal generator can be used to "line up" unbalanced tuned radio frequency (TRF) sets in easy stage-by-stage steps merely by adjusting the trimmer condensers for maximum output. It is also handy for aligning the pre-amplifier (RF) stage of a superheterodyne receiver, but it does not cover the intermediate (IF) stages.

It consists of a few old standard radio parts, a hand wound coil and a 25-watt Mazda lamp.

The simplified wiring diagram appears in Fig. 2, and the schematic circuit in Fig. 3. Insulated wire is used and the grid and plate leads should be well separated. Assembled in a 5 by 5 by 7-in. plywood case, as shown in photos B and C, the lamp socket and line-cord receptacle are flush mounted to enclose live circuit parts.

To calibrate the unit, use a broadcast receiver with accurate dial; place the oscillator on top as in photo A, and calibrate the 0 to 100 oscillator dial similar to the sample chart Fig. 1. Set receiver dial at 550 kc. and tune oscillator until set speaker gives loudest response. Note this reading on your chart, then set receiver for next reading.



FIG. 1

Sample Readings for Calibration		
Radio Frequency kc/sec	Oscillator Dial Reading	
550	95	
700	78	
900	55	
1100	35	
1300	22	
1500	13	

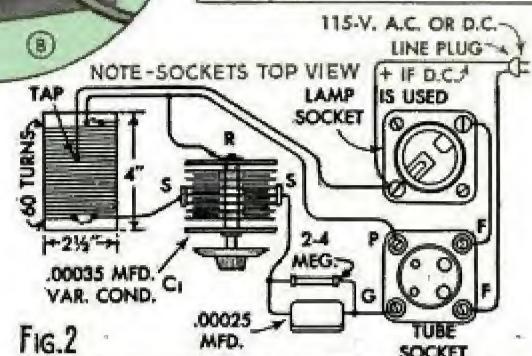
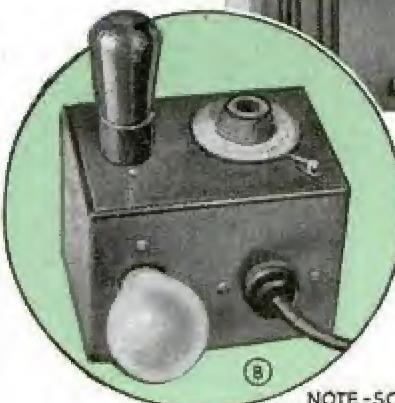


FIG. 2

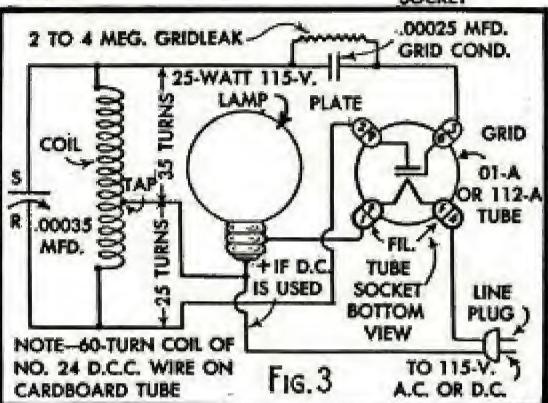
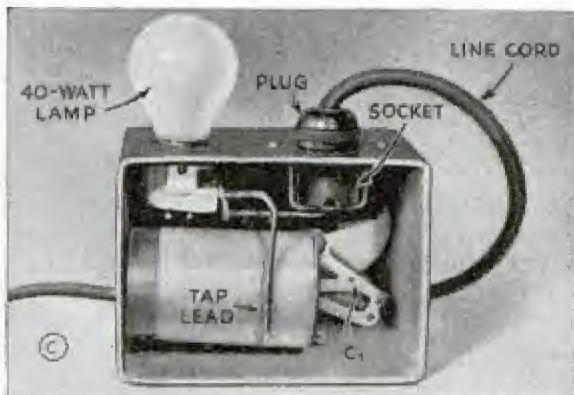
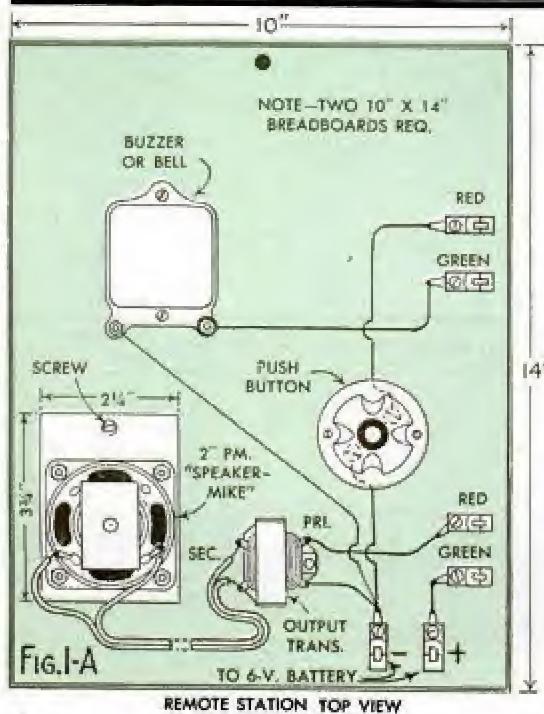
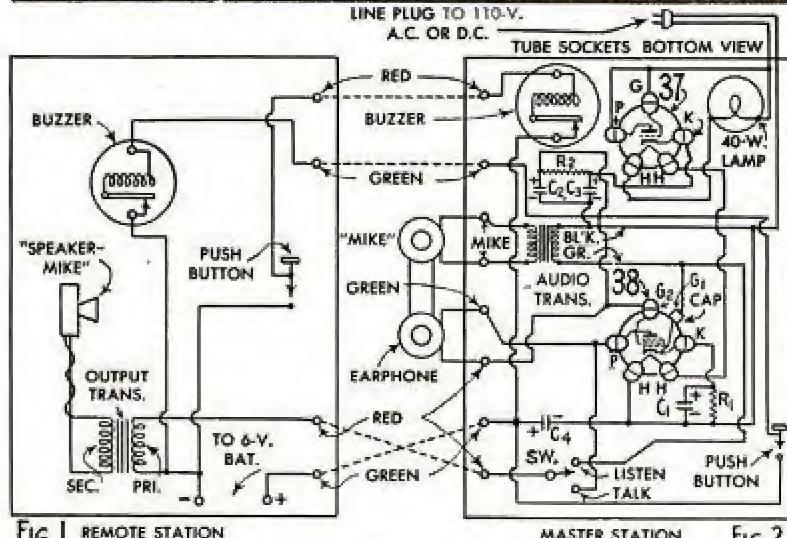
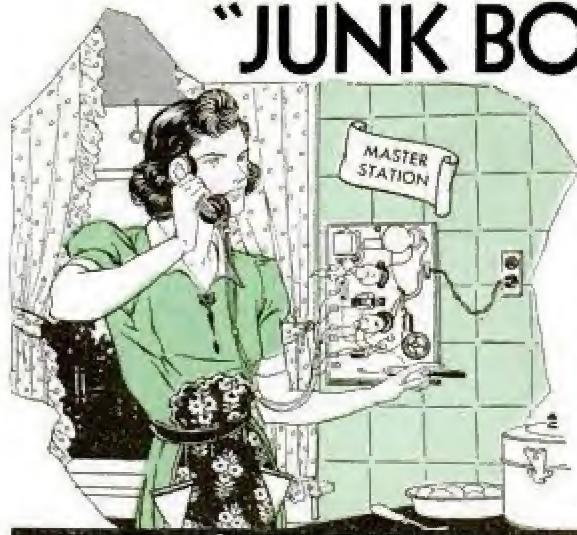


FIG. 3

"JUNK BOX" TWO-WAY

By S. A. Johnson

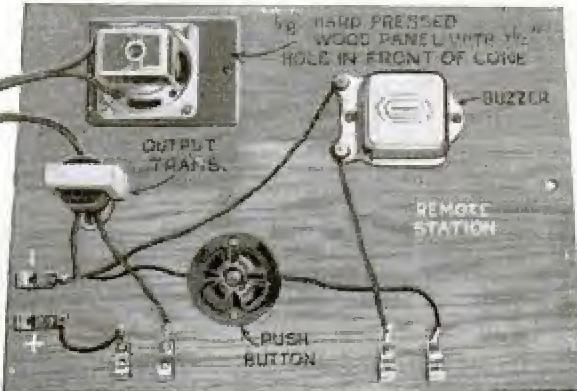


VALUABLE time and many steps can be saved with this electronic phone system. Providing two-way communication between points up to 500 feet apart, it has a wide variety of uses. It can be operated between the house and barn, or garage; between the basement workshop and an upstairs room, and similar applications. No light shows at the remote station, therefore it may be used in a photographic darkroom; many other practical uses will suggest themselves to the builder.

Although made from common salvaged parts and a few odds and ends from the "dime" store, it is a good performer and a real time saver. The breadboard units may not look as keen as the metal cabinets of peace-time, but they serve the purpose. The connecting circuit includes an independent pushbutton buzzer calling system operated from a .6-volt storage battery at the remote station. The master station employs a 2-tube audio amplifier that operates from any 110-volt line; correct filament supply for the tubes is

obtained by dropping the line voltage through a 40-watt lamp; the audio transformer ratio is $3\frac{1}{2}$ to 1.

To make it possible to use only one amplifier, a talk-listen switch is used at the master station. This consists of an old toothbrush handle, two stop screws, thumb tacks and a rubber band. An extension handle is fastened with a round head machine screw that pro-

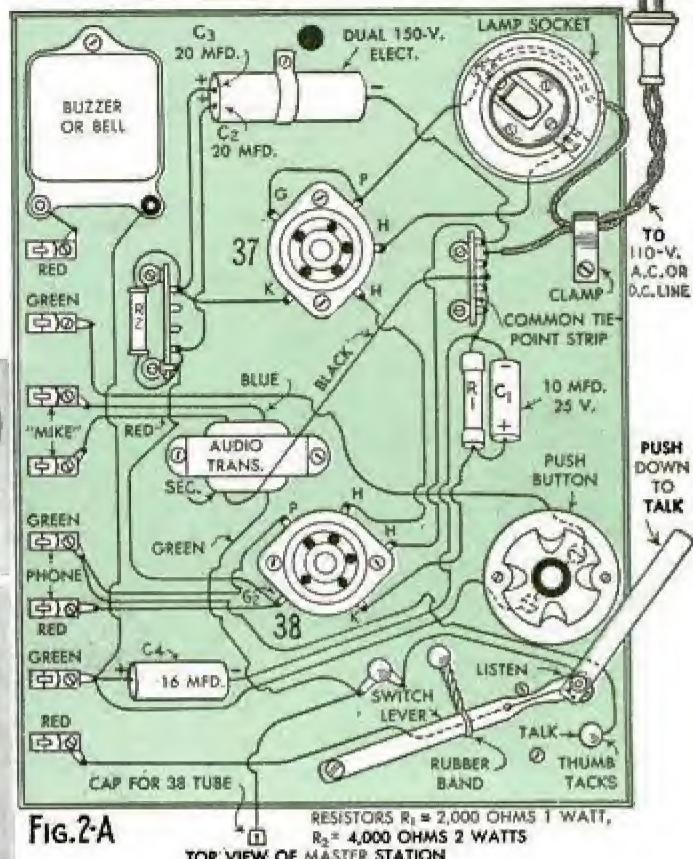
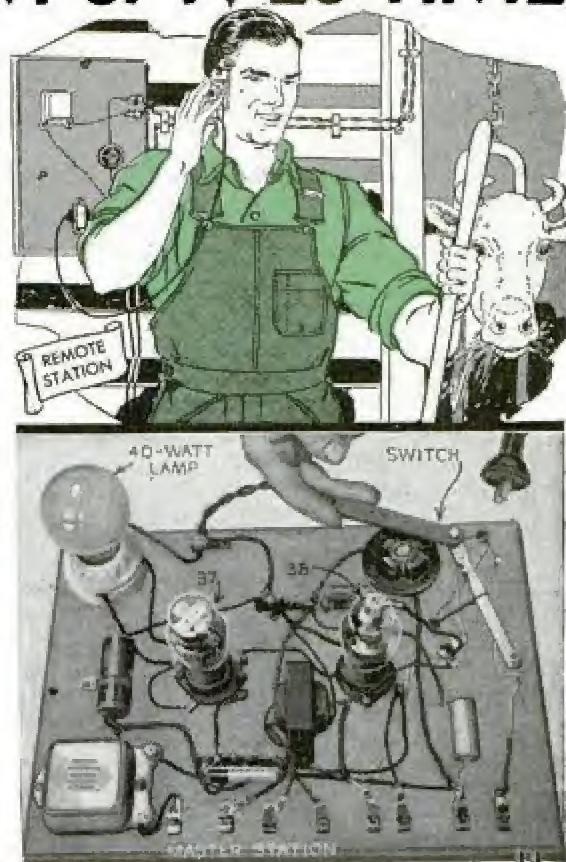
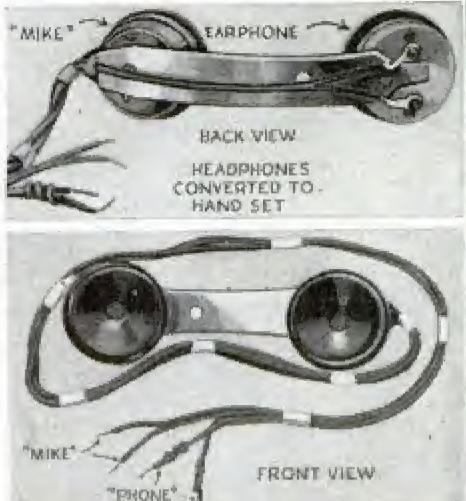


PHONE SYSTEM SAVES TIME

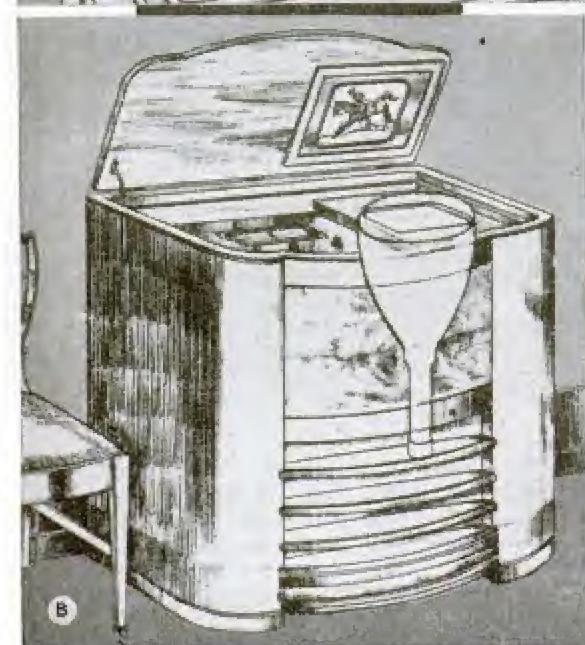
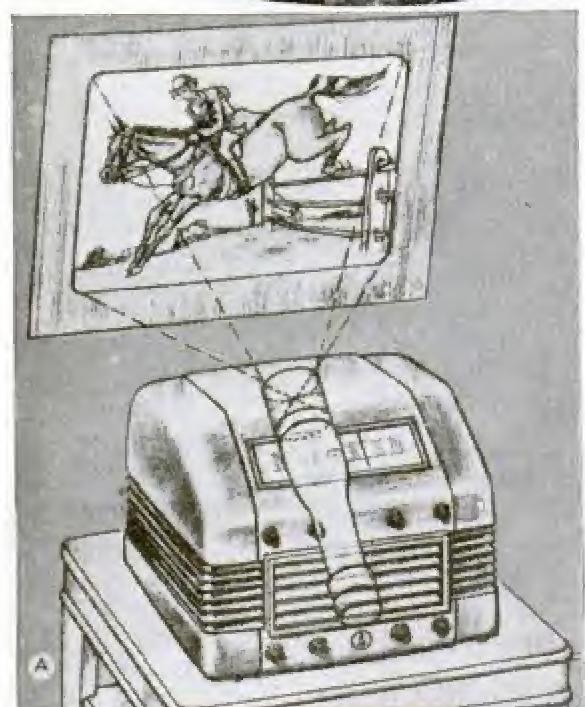
vides the switch contact. The user merely pushes this switch down to talk and releases it to listen; no switching is necessary at the remote station. The amplifier at the master station need be plugged into the power line only when conversation is required, as calling system is separate. A switch may be included in the lamp socket if desired.

Schematic circuit diagrams of both units, with color-coded connecting wires, appear in Figs. 1 and 2. Tag or identify your connecting wires in the same manner in order to avoid wrong connections. The simplified wiring diagrams are shown in Figs. 1-A and 2-A. All connections are clearly shown in these diagrams, and the photos. Detailed student material list R-324 is available from Popular Mechanics radio department, upon receipt of postage. The little P.M. speaker used at the remote station is held to the ear when listening, and used as a hand "mike" for talking. As both units are hung on the wall, this "speaker-mike" is hung on a convenient nail or screw, when not in use. The "French type phone" used at the master station is made from two old earphones fitted with separate pairs of leads, and mounted on a curved scrap metal bracket 7 in. long and 1½ in. wide, bent to the proper shape for convenient use as shown in the photos. Try reversing the earphone unit leads for strongest signals.

Any type of salvaged two-wire insulated cord can be used to connect the two stations or, indoors, four single lengths of ordinary doorbell wire may be employed.

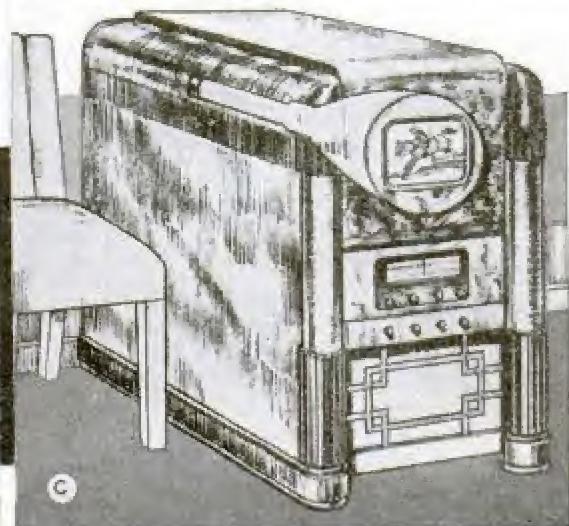


Engineers Plan Compact Low-Cost Television



PROJECTING large images on a wall screen through a lens system made of plastics, a compact instrument, approximately 18 in. wide and 14 in. high, is being planned by Emerson engineers to include a complete radio and television receiver, using a 3-in. cathode-ray tube. The engineers claim that the television image will be enlarged and projected to 15 by 20-in. proportions on a screen, with brilliance equal to that of home movies. They plan to limit the cost to \$150. An "X-ray" view of the 3-in. tube, and its approximate position in the proposed table model instrument appears in sketch A.

In the latest prewar developments of television there were three basic types of sight and sound receivers: Table models employing a 5-in., or larger, cathode-ray tube mounted for direct viewing; large consoles, in which the image is projected on a mirror mounted on the tilted lid, as illustrated in sketch B; and the conventional floor model (C) for direct viewing. The last two types employ large cathode-ray tubes, 12 in. or more, in diameter. The pooling of constructive thinking and research by radio and electronic engineers and manufacturers will effect a rapid spread of interest in practical post-war television for the home when civilian production becomes possible. It is the opinion of Emerson and other engineers that once a practical, comparatively low-priced television receiver similar to the one shown in sketch A, is available for developing mass consumer demand, there soon will be enough sets in use to support efficient commercial television broadcasting stations transmitting regular programs. Thus a great new peacetime industry will be on its way toward solving some of the problems of re-employment.



TODAY...over there



Dear Folks,
Hope you get the same
kick out of showing
these films as I had
making them. Of course



TOMORROW...back home

MOVIES BETTER THAN EVER—

WITH FINER CAMERAS, FINER PROJECTORS

Lucky is the soldier camera fan who can snatch a spare moment of refuge from war with his beloved hobby—out where scenes are exciting and subjects exotic. But when he comes home Universal can promise him still other photographic thrills. For today Universal is employing new skills, pioneering new methods in the unceasing production of fine precision instruments for our armed forces. And tomorrow, after Victory, Universal will translate these same high achievements in optical instruments into a whole series of truly great cameras and other photographic equipment. Expect your next new camera to be a Universal!



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King for the
Landscape off.

Peacetime Manufacturers of Mercury, Cinemaster, Corsair Cameras and Photographic Equipment

THE HOW AND WHY OF

USE OF WILLIAMS' KNURLING TOOL HOLDERS



The self-centering Head of this Williams' No. 1-K Holder assures equal pressure of both Knurling Rolls against the work.

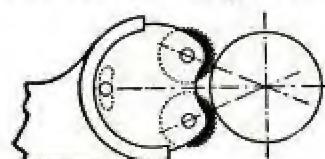
● Knurling differs from most lathe operations in that it is not a cutting, but rather an embossing or extruding operation. Knurling actually increases the diameter of the work.

Whenever possible, work to be knurled should be held between centers. Long and extremely light pieces should be supported with a Steady Rest. In other words, the work must be prevented from springing away from the cross pressure of the knurling rolls.

Set the Knurling Tool Holder well back in

the Tool Post and so positioned that top and bottom rolls are equidistant above and below center of the work, as sketched above. Tool Post screw should be securely tightened.

With lathe in slow speed, begin at Tailstock end so as to feed towards Headstock. Force the Knurling Tool into the work—*abruptly*—to approximately full depth of the knurl. This should be accomplished *before* rolls can make one complete revolution. If the



WILLIAMS DROP-FORGED TOOLS

knurling is to start at the extreme end of the work, start the Tool so that only half the width of the roll face contacts the work when forced in with the hand cross feed. Engage the longitudinal power feed and let the Tool travel across the face of the work for desired distance. Now reverse direction of carriage travel, without removing Tool from the impression, and feed back across the face of the work. Slight additional cross feed may be applied, as the carriage reverses, to further sharpen knurling.

Some machinists use oil when knurling—others prefer air pressure so as to blow all chips clear. Illustration below shows sample of knurling by both methods. Actually both samples are of about equal quality.

Unretouched photo
of work sample. Air
pressure used on

knurling at the left end—oil on knurling at right. Piece is 3/4" mild steel bar; coarse knurled with Williams' No. 11-K Holder; spindle speed 250 R.P.M.; both ends knurled with one pass up and reverse.

WILLIAMS' KNURLING TOOL HOLDERS

No. 00-K to 2-K, 4 sizes, 5/16" x 3/4" x 5" to 5/8" x 1-3/8" x 7-1/2" with self-centering Head and fitted with ONE pair of knurls.



No. 11-K and 12-K, 2 sizes, 1/2" x 1-1/8" x 6-5/8" and 5/8" x 1-3/8" x 6-5/8" with Revolving Head and THREE pairs of knurls, for fine, medium and coarse work.

KNURLS FOR WILLIAMS' HOLDERS



DIAMOND PATTERN



STRAIGHT-LINE PATTERN

Both patterns furnished in pairs, to fit standard makes of Knurling Tools, in 3 different pitches: Coarse, 14 pitch; Medium, 21 pitch; Fine, 33 pitch.

J. H. WILLIAMS & CO., BUFFALO 7, N.Y. ON USE OF SHOP AND HAND TOOLS

Your name and address in the margin below will bring 12 Tool Holder Data Sheets (punched for 3-ring binder) and a list of our complete Data Sheet series. Mail to above address, Dept. PM-5.

FREE DATA SHEETS

THIS STAR IDENTIFIES ALL U. S. MOTORIZED TRANSPORT EQUIPMENT



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**CHAMPION SPARK PLUGS
ARE ON ACTIVE DUTY!**

"Rugged" is one of the servicemen's most apt and widely used words, and rugged precisely describes them and the kind of service encountered by their mechanized vehicles—jeeps, trucks, half tracks and tanks. In this service Champion Spark Plugs meet every requirement for dependable ignition.



Champions are in the service on every front on land, sea and in the air. This is the greatest testimonial ever accorded Champion Spark Plugs—proof positive that their many exclusive and patented features really mean better performance and greatest dependability.



TO SAVE GASOLINE—KEEP SPARK PLUGS CLEAN

LET'S ALL BACK THE ATTACK—WITH WAR BONDS

BACK THE ATTACK—BUY WAR BONDS. Defoe workers take more than 10% of their pay in War Bonds



The Toughest Man in the World to Please

THE "hard-to-please" attitude of the Defoe shipbuilder is not a war measure. It's a life-long Defoe tradition. Harry J. Defoe—who founded the yard nearly forty years ago—and his crew are old hands at building sea-going vessels. They know that even peacetime ships that go down to sea must be built to withstand battering that no land-bound structure receives.

Today this experience is paying extra dividends to the Navy in the form of sound construction, added protection for crews, and lower manufacturing costs. The fleet built for

the Navy in the Defoe yards since Pearl Harbor numbers more than 65 fighting ships. And now a squadron of LCI (L) Landing Barges is taking form on the production line. These ocean-going invasion vessels are the spearhead of America's growing offensive. In making them, we pledge your sons all our skill and experience, all the Defoe tradition of safe, sound, deep-sea shipbuilding.

When Peace returns, Defoe's advanced manufacturing technique and skilled craftsmanship will provide quality products of greater value and lower cost for all Americans to enjoy.

DEFOE SHIPBUILDING COMPANY, BAY CITY, MICHIGAN

SHIPS FOR VICTORY



Defoe

SERVANTS FOR PEACE

Three White Star Renown Citations now decorate the Navy "A" Award won by Defoe workers.



Motorola Radio

"HANDIE-TALKIE" fights with

CARLSON'S RAIDERS

in

GUNG HO!

The great story of Lt. Col. Evans Carlson and his Marine Corps raid on Jap-held Makin Island can now be seen in Walter Wanger's exciting Universal war movie. It's a four-star picture!

You'll see Motorola Radio's famous Handie-Talkie at work in battles against the Jap that add greater glory to our fighting leathernecks. The picture takes its title from the Marine battle cry, "GUNG HO," which in Chinese means "work together". That's a good slogan for everyone on the home front too!

"HANDIE-TALKIE
IS ANOTHER

*Motorola
Radio
"FIRST"*

Motorola **RADIO**
FOR HOME & CAR

GALVIN MFG. CORPORATION - CHICAGO





UNCLE NED'S Home Repair HINTS



BROKEN PLASTER

It's easy to repair cracked walls with Rutland Patching Plaster. Just mix Rutland with water . . . wet the old plaster . . . and apply with knife or trowel. Rutland is the *original* ready-to-use patching plaster. Extra fine and white. Does not shrink or crack when it sets. Makes a patch as smooth and lasting as the wall itself.



HOLES IN CONCRETE

Never neglect small breaks in cement floors, walks, walls, etc. Mend them promptly with Rutland Concrete Patcher. Just mix with water and apply with trowel.

RUTLAND
REPAIR PRODUCTS

Rutland Fire Clay Company, Rutland, Vt.

Pilots Versus the Weather

Continued from page 69

venting or eliminating this ice. In some planes, alcohol carburetor de-icing equipment is also present, but it should not be used except in emergencies.

The P.I.F., as flyers call it, tells what ice does to a plane:

"It reduces the aerodynamic efficiency of the wings, thereby reduces the lift and increases the stalling speed. Reduces the aerodynamic efficiency of control surfaces and thereby reduces controllability. Increases the drag of struts, etc. Increases the load. Causes improper functioning of air-speed indicators, and other instruments that are venturi operated, by icing the venturi throats and pitot tubes. Causes engine malfunctioning due to carburetor ice. Reduces propeller efficiency."

Icing is usually heaviest between 15 and 32 degrees Fahrenheit, but has been known to form at temperatures as high as 40 degrees. On the other hand, in extreme northern latitudes, moisture, upon which formation of ice is dependent, has been found in the atmosphere at -40 degrees Centigrade. The most likely icing location, and the most dangerous, is over mountains.

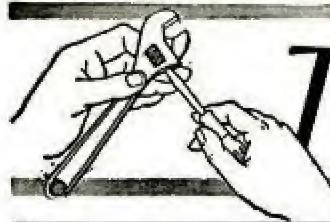
To combat ice, many effective devices have been invented. Most wing and tail de-icing systems consist of a pump supplying air to inflatable rubber shoes on the leading edges of wing and tail surfaces. As the de-icer shoes inflate and deflate alternately the ice is broken from them.

Ice on the propellers is combated by anti-icing spinners, which must be coated with de-icing oil prior to the first flight each day. A slinger ring distributes de-icing fluid to the propeller blades. Icing of the air-speed pitot tube, with consequent false readings of the altimeter and rate-of-climb indicator as well as the air-speed indicator, can be prevented by a pitot tube heater. Certain planes have windshield de-icers, which coat the glass by pumping de-icer fluid through perforated tubes.

Since flyers experience temperature ranges from 130 degrees to -50 degrees Fahrenheit it has been necessary to develop special clothing and rules for behavior which enable them to stand temperature extremes with the least discomfort.

In desert operations, for instance, the old-fashioned practice of wearing a woolen band around the middle and over the stomach to absorb perspiration and prevent stomach chills is recommended. Flyers are warned to sip water, not gulp it; to refrain from smoking, for it increases thirst; to

Continued to page 152

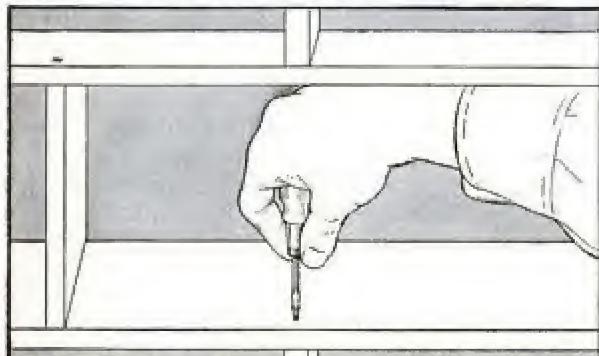


TOOL NOTES

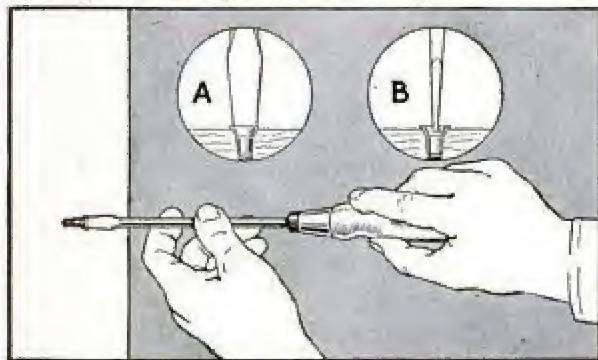
Maintenance
and Repair
Suggestions to
Prolong Tool Life

No. 16 PICKING THE PROPER TOOL FOR THE JOB

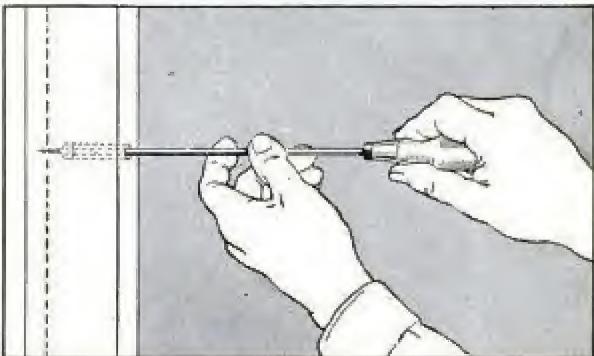
To the uninitiated, a screwdriver is just a screwdriver, but to the trained mechanic, the proper screwdriver for the job is *the* only screwdriver to use. Below are some examples:



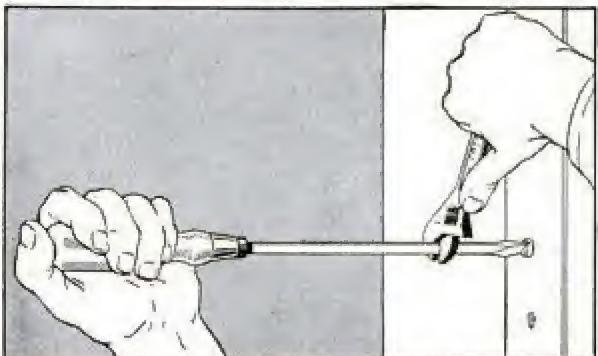
When working between obstructions, don't try to use a long screwdriver at an angle. Use a CRESCENT SHORT SCREWDRIVER. It will do the job better without marring the screw head and with less effort. Example: working between shelving.



Select the screwdriver with the proper width of blade to handle the particular size of screw being used. Inset A shows the correct blade width which is approximately the same as the screw head diameter. Inset B shows how the thickness of the blade should conform to the width of the screw head slot.



When inserting a screw in a deeply countersunk hole or electrical work where limited clearances will not admit a wide blade, use a CRESCENT ELECTRICIAN'S AND CABINET SCREWDRIVER, available in lengths varying from 6½" to 16½". Example: working in countersunk holes with short screws.



Where extra tightening pressure must be exerted, use a CRESCENT SQUARE ROD SCREWDRIVER in conjunction with a CRESCENT WRENCH as shown above. Example: tightening machine screws or oversize wood screws.

MAIL THE COUPON FOR FREE REPRINTS



This is No. 16, in Crescent's TOOL NOTES Series. These informative advertisements provide practical information for users of hand tools. Mail the coupon today!

CRESCENT TOOL COMPANY, JAMESTOWN, N. Y.

Crescent Tool Co., Jamestown, N. Y. F-6

Please send your "Tool Notes" Series
 for Bulletins for 3-ring binder

Name _____

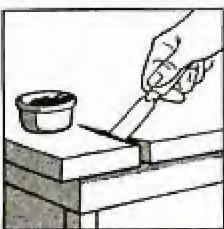
Address _____

City _____ State _____

CRESCENT TOOLS
Give Wings to Work

WORKSHOP WISDOM

How to make a good crack-filler



HERE'S a low-cost filler for building up loose joints, filling gouges or cracks in furniture—and hundreds of other uses.

Mix 1 measure of Casco Glue Powder with 1 measure of water and let stand for 15 minutes.

Then add it to a dry mixture of 1½ measures of sifted sawdust, ½ measure of flour, ¼ measure of whiting. Mix to a heavy paste, using ¼ measure of denatured alcohol to smooth the filler.

Round the filler off slightly above the work to allow for slight shrinkage. Finish off with sandpaper when dry.

Casco Glue has a 4-point advantage

Unusual strength. Casco Glue hardens and sets chemically to form a bond of remarkable strength and toughness.

Greater durability. This glue is highly resistant to dampness, heat, and age.

Easy to mix. Casco Glue mixes readily with cold water . . . no heating problems.

Economical. A little Casco goes a long way. Mix it as you need it. The powder, if tightly covered, lasts indefinitely.

For special outdoor jobs and water projects, specify Cascamite—the completely waterproof plastic adhesive.

You can get both Casco Glue and Cascamite in 10c, 25c, and larger sizes at all hardware stores.

Write a post card today for free Casco Project Booklets and free Gluing Guide containing 80 household gluing hints. Address: Casein Company of America, Dept. P-5, 350 Madison Ave., New York 17, N.Y.



CASCO Powdered Casein GLUE

"Sets chemically—hardens permanently"

take salt tablets daily. When the weather is extremely cold, it is useful to exercise enough to keep warm, but strenuous exercise produces perspiration which may turn to frost inside one's clothing. Flyers are urged to take hot drinks and hot food, and to eat as much fat and sugar as possible.

Electric flying suits, gloves and shoes have the advantage of eliminating bulkiness and resulting awkwardness in manipulating controls. They are worn like underwear, with a light summer flying suit over them, and protect the wearer in temperatures as low as —35 degrees Fahrenheit. One disadvantage is that the plane's electrical supply might fail or the flyer have to bail out. It is wise to carry a heavy-clothing kit, too. And don't try to take a reading on a magnetic compass within 30 inches of an electrically heated suit. You're likely to get lost.

Long-range weather forecasts are now a working actuality. What the weather will be like at the end of two days, or 30 days can be told "with sufficient accuracy to permit of making preparatory plans for future operations," Gen. H. H. Arnold, in command of the Army Air Forces states.

"The Caissons Go Rolling Along"

Continued from page 37

some distance away from the rest of the battery or the battalion to avoid giving the enemy advance knowledge of where our guns are located. Corrections continue to be made after the mass firing begins.

Shrapnel is out of date and the last round of it, left over from the last war, was fired some time ago. All shells now are of the high explosive type, fused to burst over the heads of the enemy or upon actual contact with a target or, in case the target is to be penetrated before the explosion occurs, after a long delay following impact.

A modern artilleryman is vastly different from the swaggering, hairy-eared cannoneer of olden times. A crack battery commander is essentially a mathematician although he solves most aiming problems with slide rules and computors.

He and his fellows will point out to you that the big howitzers and guns are the "cheapest" weapons there are for destroying targets within their reach. Their accuracy is practically perfect, the targets may be fired upon at will and for as long as is necessary. Artillery isn't "grounded" when the weather turns bad and the guns can be turned at new targets whenever they are spotted. Not even the giant rockets used by the Russians and Germans possess the fire power and accuracy of the big guns.



Stan Lewis

Don't let this happen to you...

► This family has just lost one of its most essential possessions—the family automobile. It wore out and it can't be replaced. This can happen to millions of families if they continue to neglect their engines, despite repeated warnings. An automobile engine can be worn out in a few years, or made to last almost indefinitely, depending on the care it gets.

There are men in every community who know how to protect your engine and insure its long life. They are the motor service men.

Go to one of these men, and put your car in his hands, to watch and protect. It's everyone's duty to do this, as well as good judgment.

HASTINGS MANUFACTURING CO. • HASTINGS, MICH.
Hastings Mfg. of Canada, Ltd., Toronto

★ *It's a privilege to buy War Bonds*



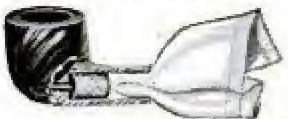
HASTINGS STEEL-VENT

Piston Rings

TOUGH on oil-pumping • GENTLE on cylinder walls



HANDKERCHIEF TEST

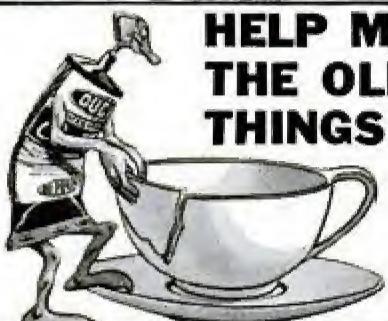


**PROVES VITAL ZONE SPOTLESS
AND FREE FROM "GOO"—no matter
how often you smoke it!**



HESSON GUARD MILANO

**HELP MAKE
THE OLD
THINGS DO!**



Mends
dishes,
glassware,
furniture,
toys and
luggage.

**DU PONT
DUCO CEMENT**

REG. U. S. PAT. OFF.

Putting on the War Paint

Continued from page 81

a system of "three-dimension" painting which reduces accidents and fatigue by scientific application of color to manufacturing machines.

But some of the best ideas for painting to fool the eye came from the men at the front. One air squadron in Asia was whittled down to its last serviceable plane. To keep the superior forces of Japs away and to impress them with the strength of the flying group, the single plane would be flown on a mission, landed and its nose quickly repainted green, or red, as the situation demanded. Thus disguised as another plane, it would take off again before the paint was dry. This trick bluffed the Japs into staying away from the field.

In the depths of the jungle, the Japs would taunt a Yank into picking up a hand grenade. They could recognize the look and glint of a yellow grenade in a flash. They knew just where to fire to knock over the American before he could heave it.

The Yanks applied paint of a protective color to the grenades, painted their throwing hands or daubed them with mud and went right on heaving grenades.

Treasure From the Dry Lakes

Continued from page 59

Today, from a big plant on the "shore" of the dry lake, a vast tonnage of war materials is being shipped over the company's "Three Elephant" railroad. Muriate of potash for agricultural fertilizers, sulphate of potash for smokeless powder and synthetic rubber, lithium for gas masks and welding fluxes, bromine for synthetic rubber and fumigants, salt cake that winds up in aircraft wings and in shell wadding, and borax products that play their part in producing optical glass for range finders, bombsights, and fire-control instruments, are all produced in the plant. It is estimated that at present rates of production the dry lake can continue to supply these needs for another century or more.

Conquering the chemistry of the lake is only part of the story. The desert itself had to be conquered so that people could live there the year around. The town of Trona with a population of about 2,000, nearly half of whom are employed in the plant, is in the Mojave desert, a region so arid and desolate that it might be on the surface of the moon. Its scenery is weird. Rainfall amounts to only four inches a year and temperatures of 118 degrees in the shade have been recorded.

Continued to page 156

THE WINNER HAS CHANGED HIS APPEARANCE, TOO



Hundreds followed him across the fairway—watched him use his skill to sink that final putt and set an unsurpassed score. Now, as he saps mines and booby-traps, his gay informal clothes are left behind. He looks different. But his character is the same.

Plumb, too, has a different appearance. Some of the finish is gone—eliminated by Government Order. Yet, the character of Plumb is the same. The one-piece steel head, tempered to faultless perfection. The sturdy handle of firm, tested hickory. The hang. The perfect balance. These are the features by which you will always recognize a Plumb tool. Yes, Plumb is proud of its service uniform. Fayette R. Plumb, Inc., 4837 James Street, Philadelphia 37, Penna.



PLUMB TOOLS ILLUSTRATED, Top to Bottom. Nail Hammer, Half Hatchet, Ball Pein Hammer, Single Bit Michigan Axe.

Quality Comes FIRST
PLUMB
is FIRST in Quality

PLUMB

HAMMERS • HATCHETS • AXES • SLEDGES

Carhartt

BROWN DUCKS

Give Extra Protection!



• You'll find these new-style 11 oz. heavy Brown Duck Carharts, with coats to match, the ideal work garment for those extra tough jobs. Structural iron and steel workers, foundry men, linemen, electricians, road builders, freight handlers, truck drivers and a host of others swear by their exclusive, extra protection, water repellent features. They give greater satisfaction, longer wear, real work comfort— are tops in appearance, protection and full cut fit.

IF YOUR DEALER CAN'T SUPPLY
you from stock send
in your measure-
ments and \$3.50.
We'll send them
charges prepaid.

WORK CAPS in ma-
terials to match.
Washable, comfort-
able, with breather
eyelets.



HAMILTON CARHARTT OVERALL CO.

Detroit, Mich.
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On sale at your local dealers

Carhartt

UNION MADE WORK CLOTHES
50 Years a Friend to Organized Labor

**SAVE THAT
MOTOR!**



Give electric tools
longer life with
Heavy Body 3-IN-
ONE Oil! Right for
electric refriger-
ators and washing
machines, too. Lubri-
cates, cleans, pol-
ishes, prevents rust.
At Hardware, Drug,
Grocery, 10¢ Stores.

HEAVY BODY

"3-IN-ONE" OIL

Early prospectors suffered from heat and thirst and some of them never returned from prospecting trips into the area. Yet today people are living comfortably here.

This seeming miracle was accomplished by common sense. Good water and proper food are necessities that the pioneers didn't possess. Potable water for Trona is obtained by pipe lines that extend to 38 different fresh water springs, plus distillation apparatus that takes over when the springs run low. Food supplies for well balanced diets are shipped in from the coastal agricultural regions in place of the coarse fare that early miners packed in with them.

Peak summer heat is intense but it is a dry heat with a humidity of only 10 percent. Homes are well insulated against outside temperatures and are provided with evaporative "desert" coolers that pull the temperature way down. The weather may drop as low as 12 degrees above zero in the winter and in some homes a steam radiator stands adjacent to the summer cooling apparatus.

Old John Searles, if he could return to the desert, would think he was seeing a mirage when he viewed Trona working on three shifts and shipping 40 railroad cars of vital chemicals out of his lake every day.

They Said It Was Too 'Hot' to Fly

Continued from page 64

above the open bomb bay, without para-
chute, working with pliers to crimp shut
the broken hydraulic lines in the hope the
landing gear could be put in operation.
After an hour the left wheel was seen mov-
ing slowly down into position—but its tire
had been shot to shreds.

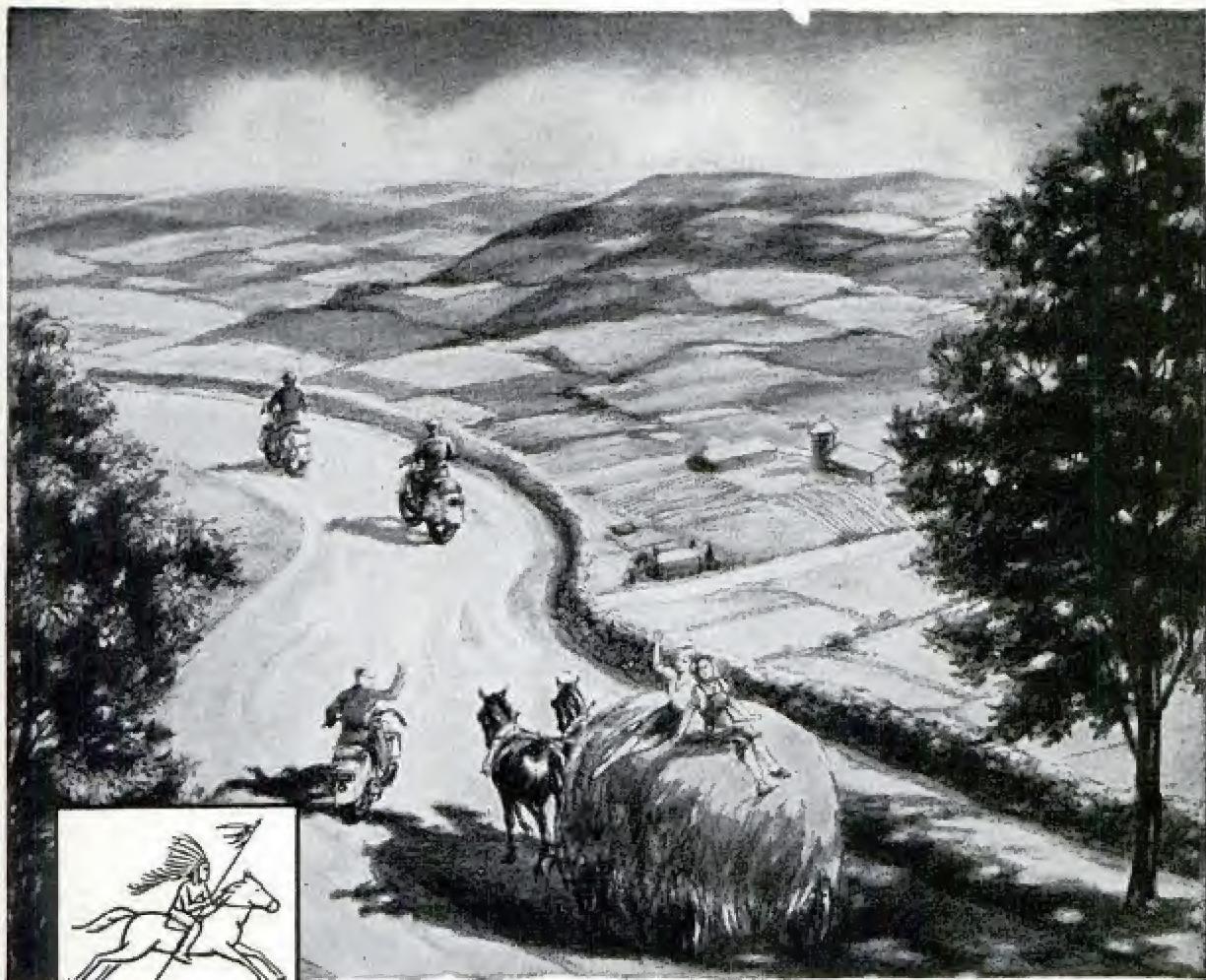
A third time Major Celio was ordered to
abandon ship. But he liked that ship.

"This is going to be a major repair job,"
the major told Operations, "so I'm going
to land at the _____ repair depot. Send
a car for me and the crew."

Somehow he did it, with one rudder
cable, easing the heavy ship down with
the weight on the good tire. As the left
wheel touched, the torn tire flew off, the
wheel dug in and the plane did a dizzy
about-face and stopped. Five days later
it was back in action.

Two or three miles above ground is one
of the most dangerous areas, well within
reach of antiaircraft shells and a play-
ground for enemy fighters; but that is the
zone preferred by the Marauders, which
flew most of the time with a Spitfire cover.
One of their neatest precision jobs was the
bombing of the Le Trait shipyard, a target

Continued to page 158



Modern Indian Trails

Just off the highways of our nation, there are a million little tempting side roads that wind their way right into the heart of this great country of ours... modern "Indian Trails," teasing you to see what's at the other end. On an Indian you can "blaze" these trails easily, safely and comfortably.

One of the biggest thrills of "trail blazing" on an Indian is the feeling that you and your motorcycle are "one." Indians are alive with power. They give you a feeling of confidence and safety... respond easily to your slightest touch... and ride so smoothly you'll find it a pleasure to reel off the

miles. Make your plans now so that when this war is over, you can enjoy motorcycling at its finest, in the saddle of an Indian.

INDIANS ON THE WARPATH

Right now, all new Indian Motorcycles go straight to war, and what a fighting record they're turning in! But new, improved, postwar Indians are already being blueprinted. *They're the motorcycles to wait for!*



**BUY WAR BONDS NOW
TO BUY AN INDIAN LATER**

Indian Motorcycle Company
Springfield, Massachusetts

Read
about
Motorcycling

Please send at once, a thrilling, action-packed FREE copy of *Indian News*.

Name.....

Address.....

City..... State.....

Indian
MOTORCYCLES

Some things haven't changed!

LHS

STERNCREST

STERLING

Every pipe produced from genuine imported Mediterranean briar of pre-war quality, and shaped by the skilled hands of master craftsmen to be "A thing of beauty and a (smoking) joy forever". Sterling Silver band; solid rubber bit. Every pipe numbered, and registered by LHS, as your guarantee of pipe perfection.

\$5

Smooth and
Antique
Finish.

Many hand-
some models.



"Perfection ... in a Pipe"

LHS STERNCREST 14K

The custom craftsmen of LHS select the very choicest grains for these patrician pipes. They finish them by an exclusive process that brings out the full beauty of the briar—circle them with a band of solid gold. Truly, "Perfection—in a Pipe"

\$7.50

L & H STERN, Inc., Stern Bldg., Brooklyn, N.Y.

Makers of the famous

LHS Ultra-fine \$1.00 Certified Purex \$3.50 Superfine Purex \$1.50

Put this in your
pipe and smoke it:

GUY WAR BONDS

330 by 650 yards, virtually destroyed along with hits on a sub and a tanker.

One day a Marauder named "Loretta Young" took a beating on a visit to Lille-Nord. It's hard to explain why she ever got home. It's one of those miracles that American manufacturers and Yankee pilots perform together so spectacularly.

"We made our bombing run OK," related 1st Lt. Milfred O. Elling, "Loretta's" pilot, "but the flight ahead turned off before we hit the target and our fighter escort went with them. We were flying the last ship in the formation. I thought 'Now is the time for enemy fighters to jump us'."

Seconds later an FW-190 came diving out of the clouds, followed by three others. Staff Sergeant Gordon A. Sampson, tail gunner, opened up on them.

"We opened up about the same time," he said, "with the FW about 350 yards away. I heard his 20mm. shells tearing into our ship, and I kept on firing a steady burst until he went down smoking."

One shell had bored through the Plexiglas tail and pierced his sleeves, grazing his left arm, tore through two bulkheads and exploded against the dynamo, shattering the turret. Another shell shot off the left elevator, a third exploded inside the right wing and sliced an aileron control cable, two more exploded inside the outboard right wing, and the right propeller took four more. The interphone went dead and the controls started jumping. Copilot, 2nd Lt. Clifford Brokaw went back to investigate, found the waist gunner binding the wounds of Sgt. Clarence S. Cyford, turret gunner. They moved him forward to be ready for "ditching" in the Channel. But "Loretta" was still under control at 6,000 feet. Lieutenant Elling told the crew to don 'chutes before he tried the landing gear and flaps over the home field.

"I didn't have enough control to prevent a dive if they didn't work," the pilot said. "I guess the others thought I wasn't going to try to take her in, but we have always been told a lot of stuff about bringing our ships back, and I thought I could. We didn't glide in. We fell like a rock. But 'Loretta' made it, and she'll fly again."

To the ground crew and the crash squads that watched her come down, Loretta's landing looked mighty sweet.

By the time you read this, grandchildren of the first Marauder may be coming off the line and the B-29 Super-Fortress may have relegated the B-26 to the category of "light bomber." Light bomber, indeed! It's 15 tons of dynamite flying at nearly pursuit-plane speed, sometimes with twelve

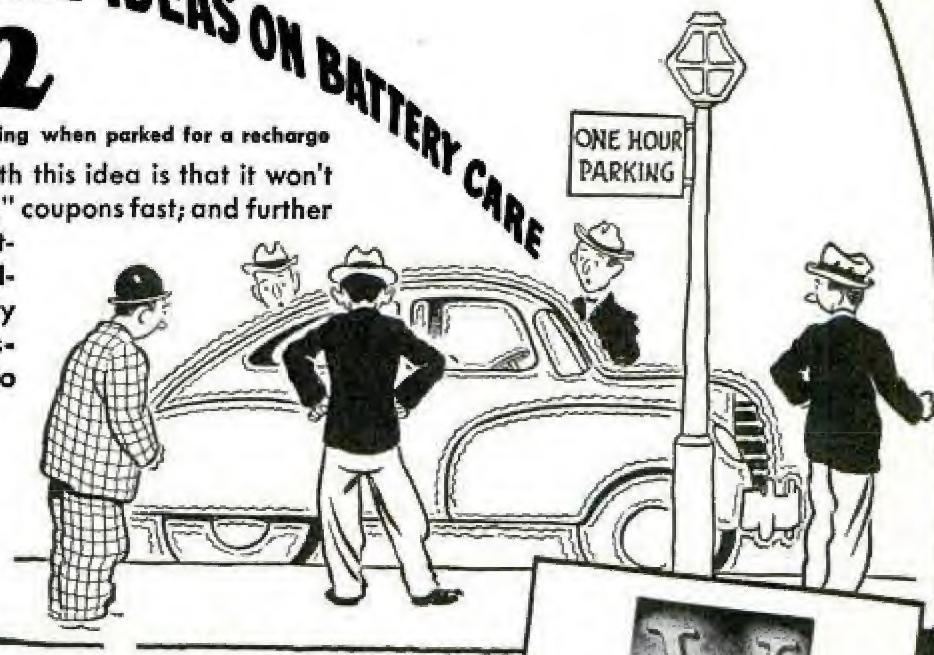
Continued to page 160

SCREWBALL IDEAS ON BATTERY CARE

#2

Leave your motor running when parked for a recharge

The only trouble with this idea is that it won't work! It burns up "A" coupons fast; and further discharges the battery because an idling motor usually draws a net discharge of from 2 to 5 amps.



...THE WISE WAY IS PERIODIC RECHARGES!

Restricted driving is hard on batteries. Rationed mileage keeps them from getting the normal recharge from the generator, making certain precautions necessary if starting trouble is to be avoided.

An experienced Exide Dealer knows how to keep batteries in top shape. See him for a check-up every two weeks. In many cases, periodic recharges may be just the right medicine for your battery, and with them, an Exide Dealer can put off the day when you'll need a new battery. When you *must* buy, get a dependable, long-lasting Exide. Buy to Last—Save to Win.

THE ELECTRIC STORAGE BATTERY CO
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

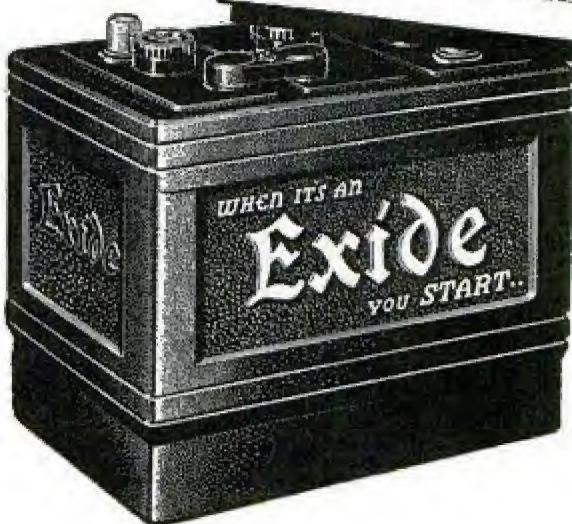
EXIDES ARE USED IN MORE THAN 100
APPLICATIONS BY OUR ARMED FORCES

1 Don't buy anything you can do without.

2 When you MUST buy, insist on dependable, long-lasting merchandise.

3 Take care of the things you have. Make them last.

These conservation rules save materials for war production, help curb inflation, give you more money to invest in War Bonds.



Coach and bus operators know that new AC Spark Plugs mean better engine performance and gasoline economy. They also know that regular cleaning and adjusting make those spark plugs perform better, longer. When plugs must be replaced, you, too, can be assured of utmost reliability by specifying AC Spark Plugs.



BUY WAR BONDS — BRING VICTORY QUICKER

.50-caliber machine guns—only one less than the four-engine heavy bombers.

When the first Marauder took the air from the Martin plant Nov. 25, 1940, it was dressed fit to kill. It wore America's first self-sealing gas tanks, the Army's first power-operated gun turrets, the first all-plastic bombardier's nose, and one of the first tail turrets. That out-thrust, pointed "stinger," the rather small, high wings set well back from the nose, the vast roar of the double Wasp engines are familiar sky-marks over the invasion coast.

The cross-Channel suburban delivery service of the Marauders was organized with two objectives: to blast the Nazi fighters out of western Europe, and to build an experienced force to support the landing boats and ground forces on Invasion Day. The objectives are being reached.

How Much Oil Is Left?

Continued from page 5

Americans had been coasting along with a comfortable oil reserve until the necessities of a gasoline and fuel oil war descended. Sharply increased demand of special products has placed a strain on our oil economy, but when the war is over it is probable that a reduced demand and the availability of drilling equipment and materials will result in an adequate supply.

The estimate of our reserves at 20 billion barrels is conservative. Certainly new fields will be discovered—they always have been, and the geologist of today is much more competent than 15 years ago. And there are new tools developing for his use.

So far we have brought 28 billion barrels of oil to the surface in the United States. We know where there are 20 billions more. No oil geologist would say we are even close to the end of our oil discoveries.

We shall find more oil—lots of it. History makes us certain.

Our Bull's-Eye Bombardiers

Continued from page 11

lights reduce the bombardier's vision. On mass bombing raids care must be taken to avoid collisions. Thickness of traffic on a big raid has led to a new kind of mass bombing. The planes make their approach in close formation. The bombardier of the leading plane uses his bombsight to hit the target's center, while bombardiers of the other planes release their bombs manually upon seeing the leader's bombs drop away. From 20,000 feet or more, one-quarter to one-third of all bombs dropped this way

Continued to page 162

"Always Ready FOR ANY TEST"

HERE'S another typical letter from our far-flung battle fronts:

"In the past six months I've been riding Harley-Davidsons somewhere in North Africa. Have ridden other makes but none take the punishment that the Harley-Davidson has taken. I usually put about 200 miles a day on my motorcycle—so you can see I know what I'm talking about. She is ever faithful, always ready for any test."

That's the story of Harley-Davidson stamina and dependability in a nutshell. BUY WAR BONDS NOW—get set for your new Harley-Davidson as soon as the "fracas" is over—and the days come again for the fun and thrills of hillclimbs, endurance runs, race meets, gypsy tours and other exciting motorcycling events!

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Dept. P., Milwaukee 1, Wisconsin

Write for free copy of ENTHUSIAST MAGAZINE
filled with motorcycle pictures and stories.

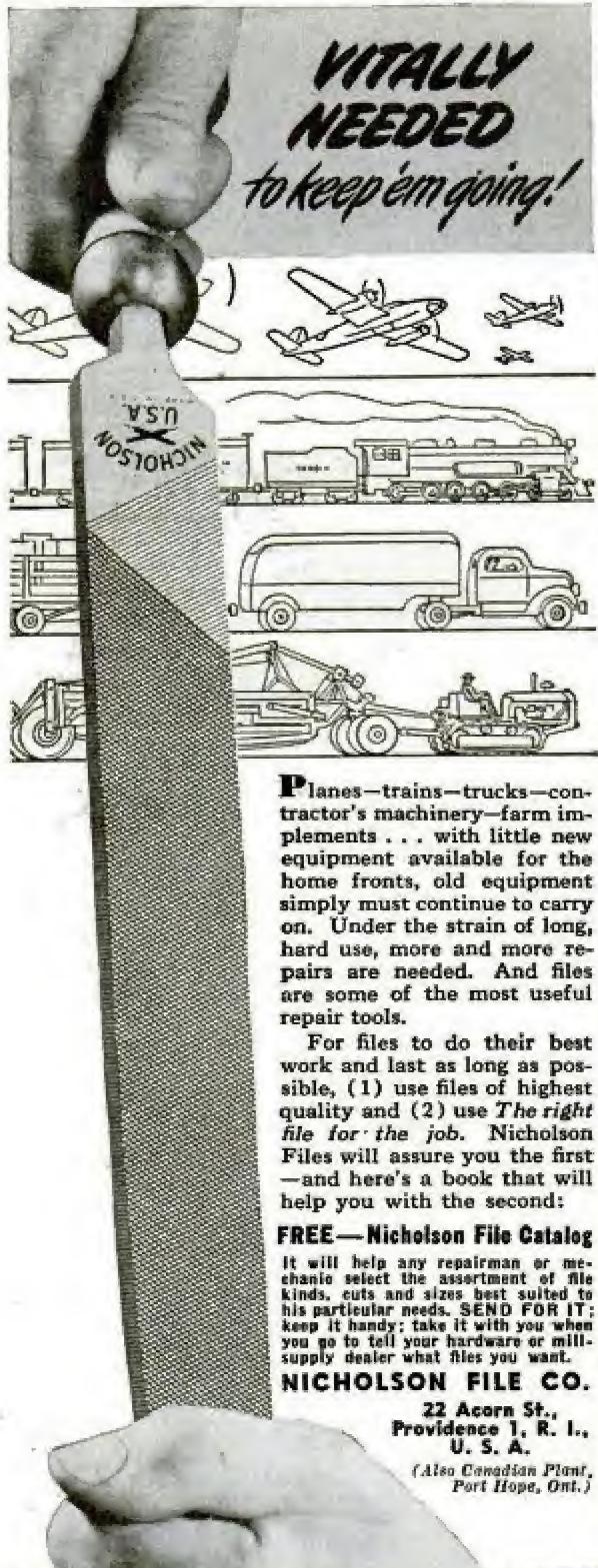
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City _____ State _____

FREE!

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Planes—trains—trucks—contractor's machinery—farm implements . . . with little new equipment available for the home fronts, old equipment simply must continue to carry on. Under the strain of long, hard use, more and more repairs are needed. And files are some of the most useful repair tools.

For files to do their best work and last as long as possible, (1) use files of highest quality and (2) use *The right file for the job*. Nicholson Files will assure you the first—and here's a book that will help you with the second:

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It will help any repairman or mechanic select the assortment of file kinds, cuts and sizes best suited to his particular needs. **SEND FOR IT;** keep it handy; take it with you when you go to tell your hardware or mill-supply dealer what files you want.

NICHOLSON FILE CO.

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U. S. A.

(Also Canadian Plant,
Port Hope, Ont.)

**NICHOLSON
FILES FOR EVERY
PURPOSE**

NICHOLSON
U. S. A.
MADE IN U. S. A.

land within 1,000 feet of the target's center.

For training, a wooden mock-up of the bombardier's compartment is mounted on high legs, with motored wheels so that it can creep over enlarged aerial photographs of typical target areas at a speed scaled to the photographs. From his seat in the overhead mock-up the trainee with his bombsight picks out the target on the map and goes through the bombing procedure.

Usual high-altitude bombing techniques must be modified against enemy war vessels that maneuver violently as the bombers approach. One dodge used by Jap and German ship captains is to keep going straight ahead at full speed, meanwhile watching the bomber through binoculars. The instant the bombs are seen to fall from the plane, the ship makes an abrupt turn. One solution to this has been to bomb short so that the bombs will come closer to hitting the target no matter which way she turns. Sometimes a Jap ship steams in a wide circle to escape falling bombs, a maneuver that doesn't always work if there are several planes that can drop a pattern of bombs across her route. Skip bombing from mast height is another method.

Flying Gas Jet

Continued from page 15

adaptation of the gas turbine, a new kind of engine, simple, light, and efficient, burning a mixture of air and some such fuel as kerosene or fuel oil. The hot expanding gases of combustion whirl the blades of a turbine wheel as they move toward an exhaust port. The turbine, in turn, is geared or shafted to a supercharger that continues to pack air into the combustion chamber. Excess power not used by the supercharger can be put to other work.

The principle of the gas turbine has been known for a long time but there were no metals that could withstand the heat of the combustion chamber and be used for turbine blades. Satisfactory semi-refractory metals have now been produced. In its aircraft adaptation, the turbine wheel of the gas turbine uses only enough power to operate the supercharger. The exhaust gas, still under pressure, jets out at high velocity through a rear nozzle. The sustained, high speed flow of exhaust gas provides the thrust that moves the airplane ahead.

A true rocket is not the same thing. A sky rocket or bazooka shell, two examples of rockets, each gets its drive from the jetting of gases manufactured by its own fuel, independent of the atmosphere. That is, a rocket carries its own oxygen supply, often

Continued to page 164

**Zenith's Crusade to Lower the Cost of Hearing
Brings High Quality within Reach of All!**

The New Zenith Radionic Hearing Aid

Another Zenith "First!"

DAILY, all over America, hard of hearing persons who had given up hope of being helped, or who could not afford an adequate hearing aid, are finding a new world of happiness. They are discovering the thrill of "Radionic Hearing" with this high quality precision instrument at about one-quarter the price of other vacuum-tube instruments on the market today!

Zenith, pioneer in radionics and world's leading manufacturer of radionic products exclusively, has brought the hard of hearing "Another Zenith First." It places the fine precision quality that modern science and engineering can produce within reach of all who need it.

If we at Zenith never made a dollar on the New Zenith Radionic Hearing Aid, we would feel repaid a thousandfold by the expressions of delight, the smiles and in many cases the tears, of sheer gladness on the faces of these grateful people.

For the first time, many of them are able to hold vital wartime jobs and do their rightful share in Uncle Sam's wartime emergency. Many are hearing, *for the first time in years*, the voices of their children, their families, their friends. Handicapped youngsters, too, can now be saved from lives of failure and misunderstanding due to hearing deficiencies. 78% of all who are buying this revolutionary new instrument have never owned an adequate hearing aid before!

If you are hard of hearing, you owe it to yourself—your friends—and your country—to see a demonstration of the great advantages which ONLY ZENITH offers in a hearing aid. If you have a relative or friend who is hard of hearing, *you owe it to them* to urge attending a demonstration now going on at your local optical establishment franchised by Zenith. Let *their* ears be the judge. No one is pressed to buy. No salesman calls at the home. Meanwhile, send for our free descriptive booklet.

To Physicians: A detailed scientific description will be sent upon request. Further technical details will appear in medical journals.

*

There are cases in which deficient hearing is caused by a progressive disease and any hearing aid may do harm by giving a false sense of security. Therefore, we recommend that you consult your otologist or ear doctor to make sure that your hearing deficiency is the type that can be benefited by the use of a hearing aid.

Write for Free Descriptive Booklet, Address Dept. PM-5

ZENITH RADIO CORPORATION

P. O. BOX 6940A, CHICAGO 1, ILLINOIS
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\$40

READY TO WEAR

Complete with Radionic Tubes, Crystal Microphone, Magnetic Earphone and Batteries. One model—no "decoys" . . . One price—\$40 . . . One quality—our best. Covered by liberal guarantee.

Accepted by American Medical Association
Council on Physical Therapy

ONLY ZENITH GIVES YOU:

1 The fine precision quality that modern knowledge and engineering make possible in a hearing aid, yet priced at only \$40, complete, ready to wear. One model—no "decoys" . . . One price—\$40 . . . One Quality—our best. You need not pay more or accept less.

2 Four-Position Tone Control. The flick of your finger instantly adjusts it to the most effective combination of low, medium and high tones for individual needs in varying surroundings, hearing deficiencies in various ranges. No further adjustments necessary.

3 Special Battery-Saver Circuit. Insures economy in battery consumption . . . results in substantial saving of battery life and battery replacement expense.

4 Zenith Quality—Zenith Guarantee. Zenith, world's leading manufacturer of radionic products exclusively, is fortunate in having the knowledge of precision production that makes possible this quality hearing aid at a remarkably low price. Guaranteed for a full year, with unique service insurance plan.

The Zenith Radionic Hearing Aid is available through reputable optical establishments franchised by Zenith.

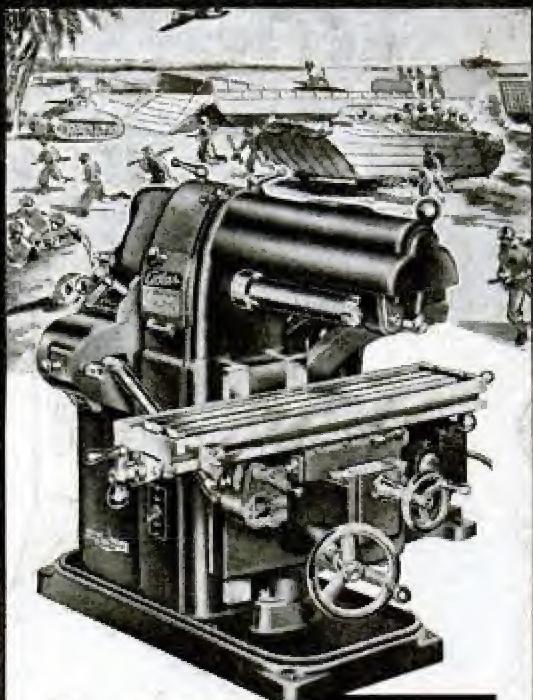
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In hundreds of war plants, Atlas Bench Milling Machines and other Atlas machine tools help deliver the precision that puts the punch in our fighting machines.

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BONDS
NOW

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AFTER THE WAR

liquefied oxygen. It can move in a vacuum. A jet propulsion airplane takes on air and mixes it with fuel for combustion. Each type moves ahead by pushing against the expanding column of its own exhaust gas.

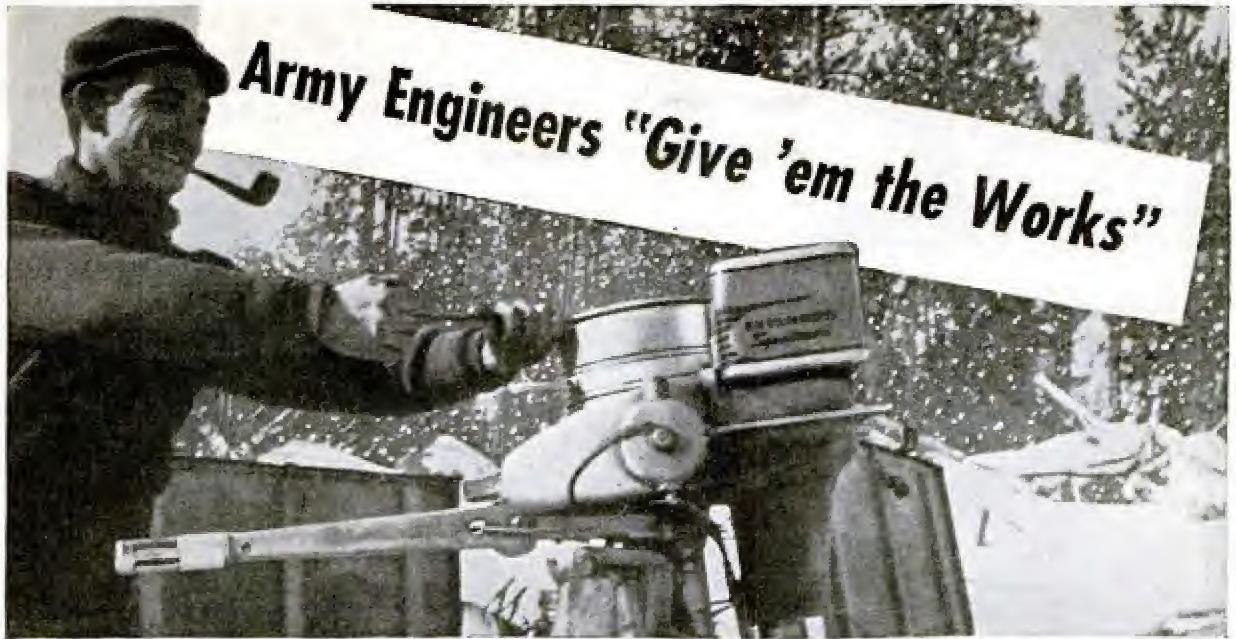
A modern gasoline engine, with its accessories, makes up some 30 percent of the gross weight of a plane. Gas turbines are simpler and lighter, use lower grade fuel.

True rocket motors are handicapped by the weight of their fuel loads, which must be burned at great speed to provide thrust. This limits a rocket to a short period of operation. However, auxiliary rocket motors that exert their thrust during the taxi, take-off, and climb can boost a heavy airplane up to a safe operating altitude where the plane's regular engines can maintain its flight. Ordinarily an airplane can cruise with about 50 percent more cargo than it can lift from the ground. Another use for true rockets may be in aircraft that are lifted by propellers or jet to the thin air of high altitude, where rocket motors could be turned on to provide a fast speed.

Our first jet plane is powered by General Electric motors. Air Force described its weird sound effects thus: "When at some distance away, it sounds not unlike a train rumbling along, far away at night. Some people say it wails like a tired banshee. You seldom hear a jet propelled plane until it is almost past you. As it goes away you hear the roar of the jet....

"It has been reported from England that hats and coats have gone through the engine when mechanics move right up against the intake while the engine was screaming its warning during ground runs at high rpm. Another little legend about the 'Squirt' started in England. It was that birds flying into the intakes emerged dressed and skewered, suitable for serving. The plane, which doesn't announce itself, could sneak up on a goose, but that is not considered a problem since the intake ducts are designed so that miscellaneous objects are not attracted into them."

An intriguing propaganda story out of Germany tells of a new rocket explosive or fuel which, if it has been developed, would be a revolutionary source of power. The story indicates that unstable elements made radioactive in some such device as a cyclotron, have been combined with other elements to produce terrific explosions. The announcement is the same as saying that the Germans have gone part of the way in extracting power from the atom. When such a discovery is actually made, civilization will have a new source of power so efficient that petroleum and coal would become second class fuels.



"What would the Army do with-out the En-gi-neers?" pops the \$64 question in "Song of the Engineers". A hard one to answer! Wherever the Army advances, in tropic jungle or Arctic outpost, the Engineers are out in front preparing the way . . . building air fields . . . throwing bridges across broad rivers . . . constructing highways over formidable mountains . . . resourcefully transforming "impossible" assignments into routine tasks.



Speed is a vital factor with the Engineers, and outboard motors have proved highly useful in ferrying and bridging operations. The Evinrude above, fresh from its packing case, will soon know what it is to "get the works" from the hard-working Engineers.



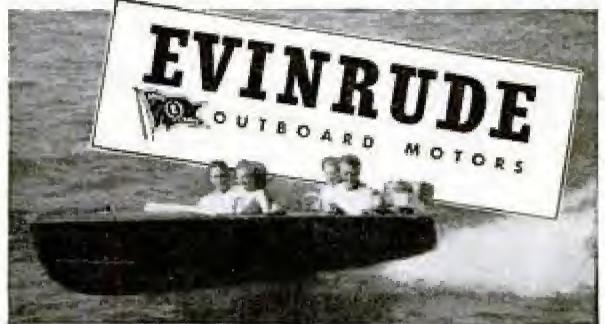
1 Mounted on the stern of a standard Engineers' pontoon, (the Army term is *pontoon*, not "pontoon"), this Evinrude makes fast work of transporting bridge material. It takes *stamina* as well as power to deliver the goods in this kind of service!



2 Ferries built quickly — here's how the Engineers do it! Several pontoons are decked together with standard bridge material and, with motors mounted, the ferry is ready! Here 3 Evinrudes do a "triple screw" job pushing a truck up stream.



3 Ready to go with another load. Such service is not as spectacular as that performed by the great Evinrudes that drive the Engineers' speedy Storm Boats, but it's as important — and it may have to be performed under battle conditions!



4 After Victory there will be thrilling new Evinrudes for all to enjoy! Today it is our job to deliver to our fighting forces the finest motors that all our skill and long experience can build! EVINRUDE MOTORS, Milwaukee, Wisconsin

EVERY DOLLAR YOU INVEST HELPS SPEED VICTORY . . . BUY MORE WAR BONDS

BEFORE STARTING DIRTY WORK

Rub on
"PRO-TEK"
like a
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When
through work,
grime and paint
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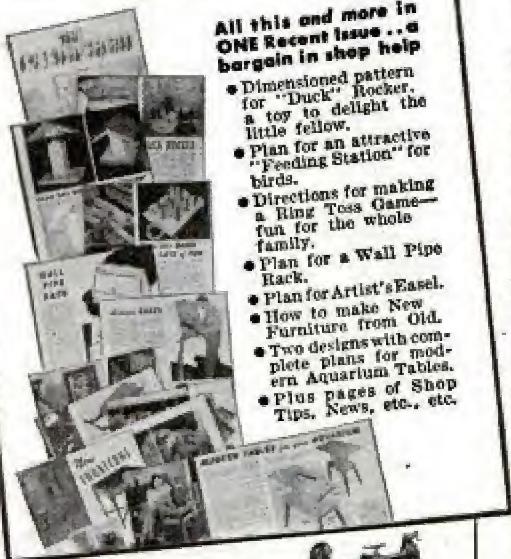
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Published six times a year by the world's largest manufacturer of home power tools, The Deltagram is practical in every detail. Every project plan (and there are about

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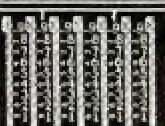
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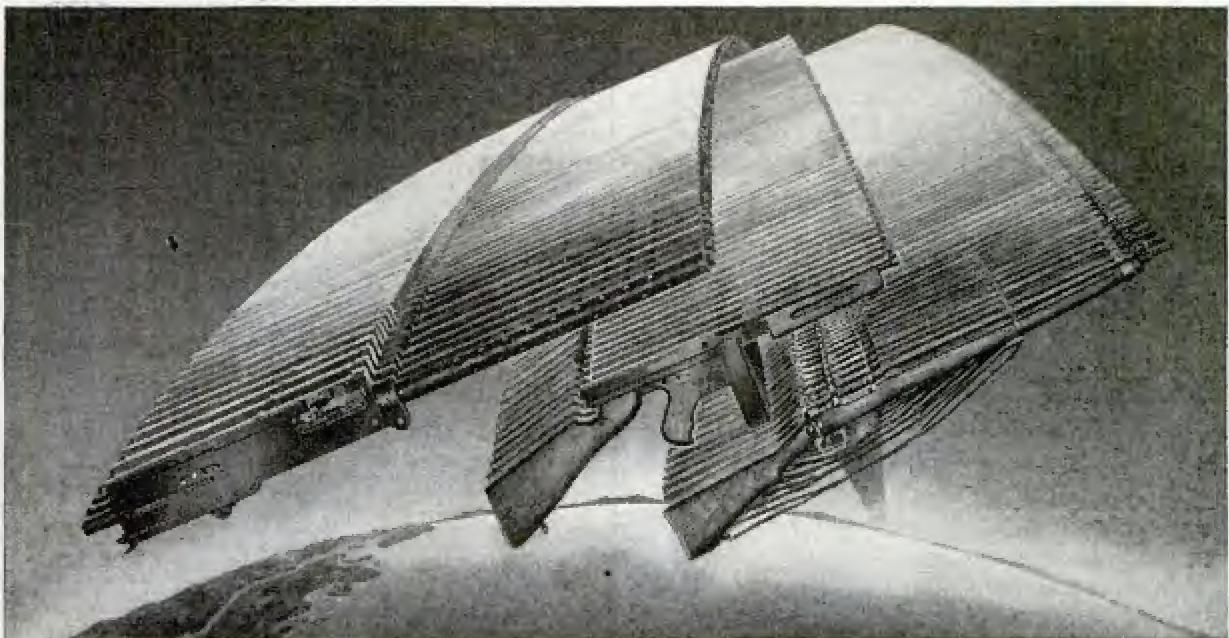
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The following excerpt from an official letter to Savage from the Army Service Forces, Office of the Chief of Ordnance, speaks for itself.

"I congratulate all members of your organization on the fact Savage Arms Corporation plants in Utica, New York, and Chicopee Falls, Mass., have produced more than 2,000,000 military small arms weapons. This is truly a great record."

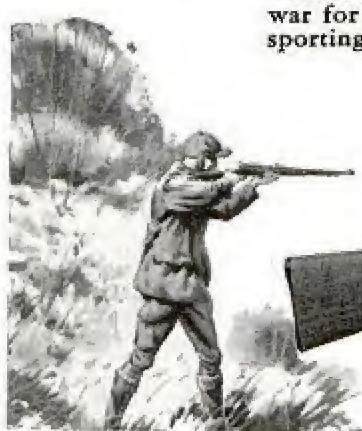
"The Rochester Ordnance District relied heavily upon your Utica organization to give us submachine guns and aircraft type machine guns when they were most urgently needed."

"You did not fail us, and you produced not only the required numbers of these arms, but they have been proven most dependable in battle."

The same Savage skill which has produced more than two million weapons of war for our fighting men will make certain a great peacetime line of Savage sporting arms for every shooter and every shooting requirement.

Savage Arms Corporation, Utica, N.Y.

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Automatic .22 Rifle**

Before the war... an extremely popular type of rifle for small game and vermin shooting.



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Pencils moving in circles illustrate principle of orbital motion!

EASY TO OPERATE! FAST!

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Superior to hand or ordinary machine sanding in both quality and speed. Orbital motion of Sterling sanding pad produces a uniform extra-smooth surface on wood, metals and plastics.

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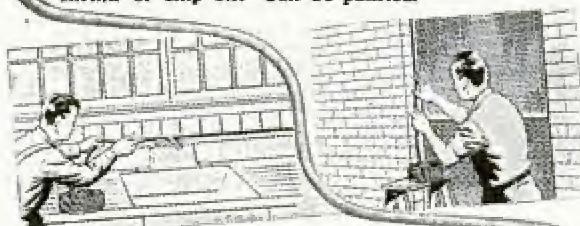
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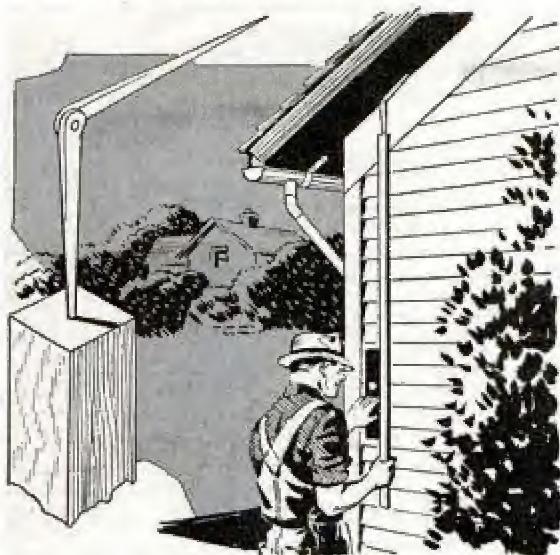
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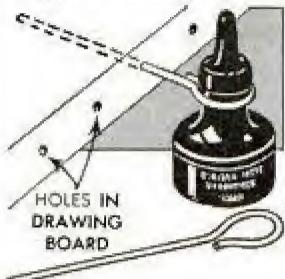
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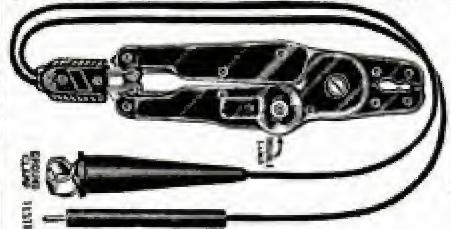
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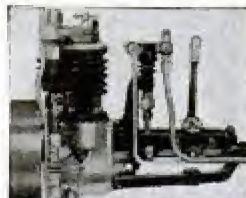
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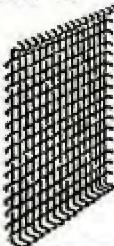
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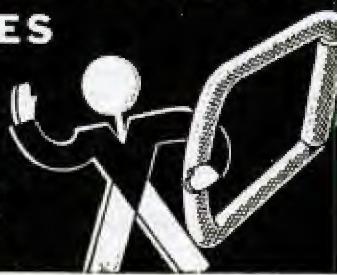
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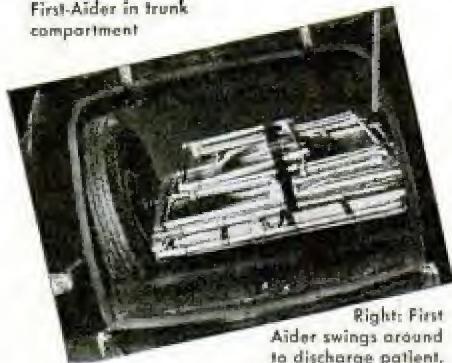
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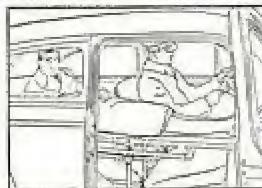
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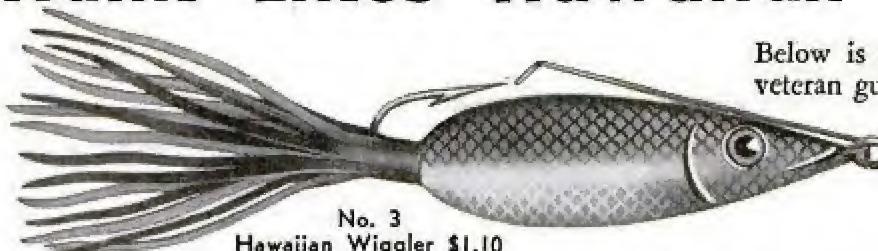
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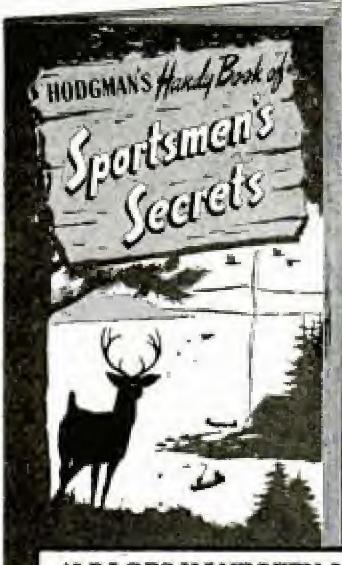
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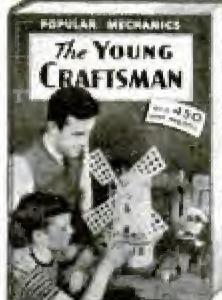
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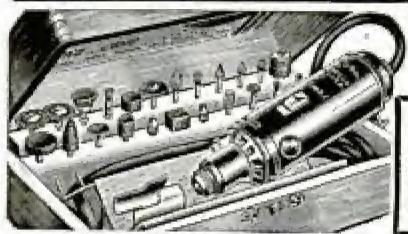
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"One of the World's Largest Builders of Arc Welders"



Am interested in a _____ amp. Welder for immediate delivery.

Send items checked—no obligation.

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Gum-Tite CLEANER
with every tube of . . .
MIRACLE ACTION



SEND NO MONEY

GUM-TITE has a money-back guarantee, and if you are not satisfied in five months, return empty tube and dollar will be refunded. For snug, happy mouth comfort order GUM-TITE at once.

TIGHTENS YOUR FALSE TEETH LASTS 4 to 6 MONTHS

Keeps Food Out Easy to Use

Smooths Gums
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Why be embarrassed by loose, slipping teeth that hiss and click? Eat what you want and have that feeling of having your own teeth. You just tighten them with smooth-flowing, long-lasting GUM-TITE without risking even a penny. If you are not satisfied, just return within five months for refund. Its miracle action forms a comfort cushion which soothes your gums, keeps out food, bans denture breath, EASY TO USE—APPLY IT YOURSELF. Just wash the plate dry well. Squeeze GUM-TITE on plate—put plate in mouth. In a jiffy your plate feels like new and stays that way. GUM-TITE is the one and original plastic reliner. Not a powder or paste! It doesn't burn or irritate. Save yourself from discomfort and embarrassment by writing for GUM-TITE today.

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Please send me free your GUM-TITE cleaner. I will pay postman \$1.00 (or \$2.50) plus postage on arrival.
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RUSH! your order
for a tube at
only \$1.00 (3 for
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be 100% satisfied.
If not, your
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H-C PELLETS ARE AVAILABLE

at dealers or direct. Cal. .22 and Cal. .177. Production of all models Benjamin Air Rifles and Benjamin Air Pistols has been suspended for the duration as our facilities are engaged in War Work. WRITE FOR OUR ILLUSTRATED PRICE LIST and BUY MORE WAR BONDS.

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BRUSH PLATING OUTFITS

- for autoparts, reflectors, faucets, bicycles.
- No tanks necessary. Free particulars.

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Heavy Chrome Plate

\$10.00

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A thousand
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Fully tested
pencil lead

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Compass has replaceable steel pivot point. Pencil chuck removable for all size leads. Attachment for two steel points for die and pattern makers. Micro-adjustment screw for fine work. Additional clip supplied for added pencil or scribe. \$10.00 post paid.

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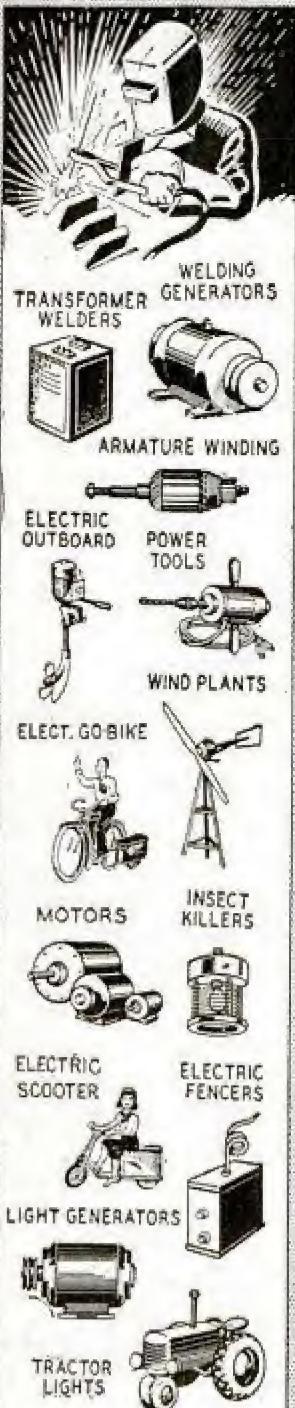
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ELECTRIC
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Maintenance men, farmers, mechanics, machine shops, foundries, auto, general repair and job welding shops using the DYNAMIC WELDER find it so indispensable and useful that they cannot afford to be without it. If inexperienced you can easily learn to do a variety of high-grade welding jobs by following the practical simplified operating and welding instructions furnished.

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Repair Shop Owner says, "It will do more than you say."

"I want to say I operate a repair garage and am more than satisfied with the welder. It will do more than you say."

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It's the Greatest Portable Outfit

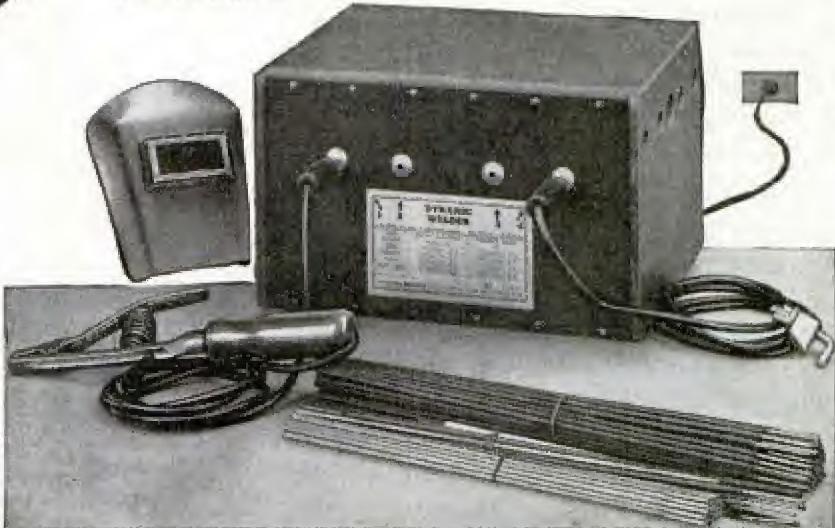
"Now I am equipped for all kinds of welding and before I go further I must say it's the greatest portable outfit for welding any man could ever wish to own. I wouldn't sell mine for the cost of plenty welders I have seen which were very high in cost but not in convenience. You may put me on file as a booster of your wonderful welding product."

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Better Than I Expected

"I have done quite a little welding with my welder and will frankly say it is better than I expected. The price, convenience and variety of work that can be done with the Dynamic are the attractive points."

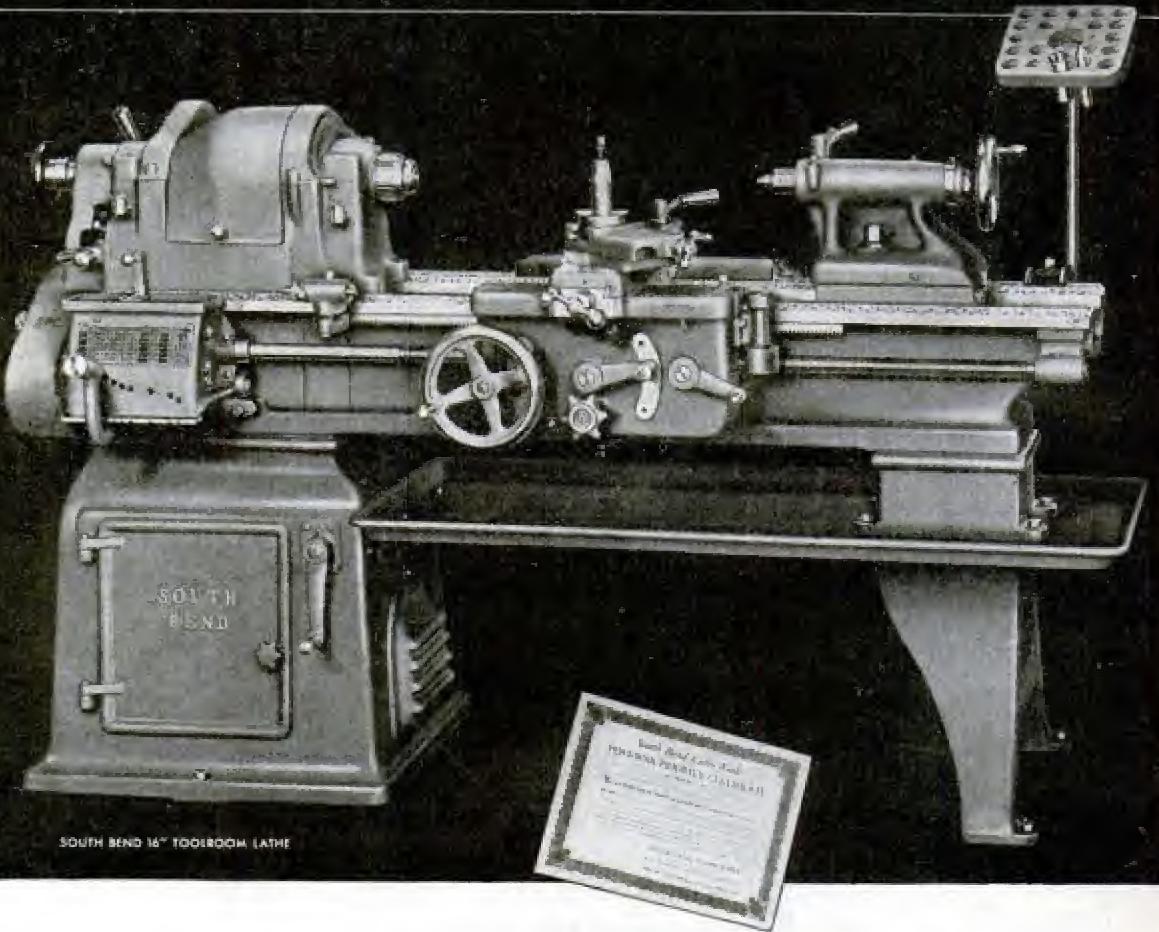
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DYNAMIC WELDER CO.

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While producing for war is still America's No. 1 job—the time to look ahead to the greatest era of peace-time production is now. Ordering post-war machine tools immediately is the first step in reconverting to peace-time production. Early delivery means quicker reconversion—a very important competitive factor.

Where future-planning includes new lathe equipment, South Bend Lathe Works offers a practical post-war priority plan. You can place your order now for any South Bend Lathe. No deposit or down payment is required. We ask only that your order be placed in good faith. Each order received will be acknowledged by a numbered Post-war Priority Certificate.

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Investigate this effective plan that will help strengthen your post-war position. Write now for full details of our Post-war Priority Plan and a copy of Catalog 100-C.



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LATHE BUILDERS FOR 37 YEARS

SOUTH BEND 22, INDIANA

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You, personally, can save a soldier's life by giving a pint of blood to the Red Cross. They maintain Blood Donor Centers in 35 cities. Call for an appointment now!

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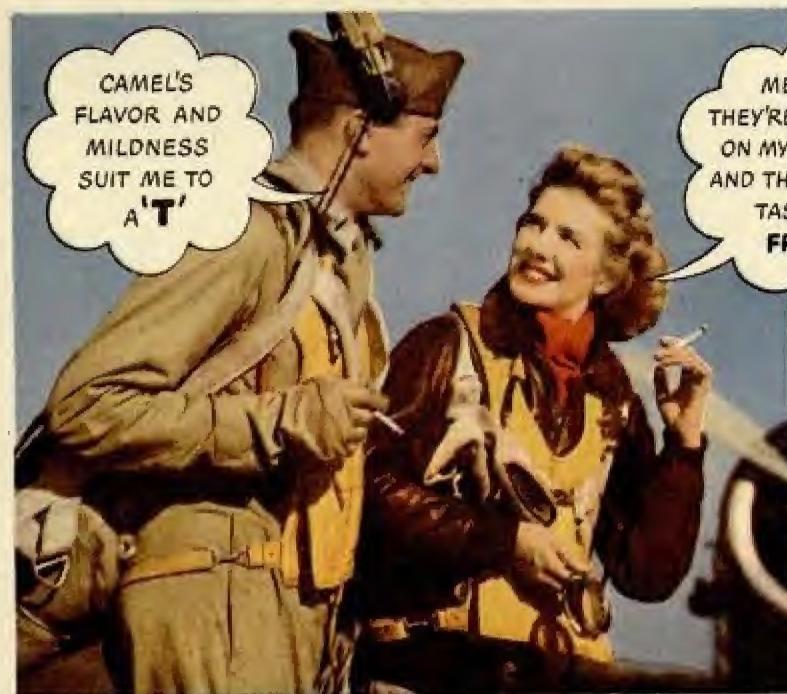
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GOT
WHAT IT
TAKES!

Young Lady with a Lens

CAMERA GUNNER! Sergeant Florence aims her special aerial camera at the terrain far below. When the film is developed—few secrets are hidden from Sergeant Florence's camera!



...She's a Marine—and a camera sharpshooter of Marine Aviation, whose aerial pictures are used in vital map-making. Her rank is Sergeant...Sgt. Florence _____ (full name omitted by regulation), of the Marine Corps Women's Reserve. Her cigarette is Camel—the favorite with men in the Marines, in *all* the services. "I like everything about Camels," says Sergeant Florence, "especially their *freshness!*" That's right, Sergeant Florence! Camels stay fresh—they're packed to go round the world!



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• Give Camels a try. Compare them for taste, for your throat...your "T-ZONE." On the basis of the experience of millions of smokers, we believe you will like the extra flavor Camel's costlier tobaccos give. We believe your throat will confirm the findings of other smokers.

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